The Presence and Nature of Dizziness in Adults Living with HIV Attending HIV Clinics in the Western Cape

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Declaration

I, Jay Chouhan, hereby declare that the work on which my dissertation is based is my original work (except where acknowledgments indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

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Abstract

Objective: This study aimed at describing the prevalence of dizziness in adults living with HIV and to explore relationships between patient report and clinical and laboratory assessments of vestibular function.

Method: A survey design using a quantitative descriptive approach was adopted for this study, which was implemented through case history, clinical bedside and laboratory assessment of vestibular system function. The collected data were analysed using descriptive and correlational statistics, which were used to describe and relate dizziness experience of the participants to clinical and laboratory findings. A system to classify dizziness based on patient report was developed; Patient-Report-Diagnosis algorithm.

Results: Results suggested that the prevalence of dizziness in people living with HIV/AIDS was high (47%). Case histories were taken and self-assessment scales were administered to all (n=32) participants. The PRD model was used to classify dizzy participants into the four dizziness types and to identify possible aetiologies and triggers of dizziness. Fifteen participants reported experiencing dizziness (vertigo n=3, dysequilibrium n=2, light-headedness n=1, non-specific dizziness n=9) and 17 participants reported no dizziness experience. The PRD was able to identify possible triggers of dizziness in the dizzy participants. Three participants (20%) were identified to have peripheral triggers, two participants (13%) having central triggers, one participant (7%) as having a vascular trigger and nine (60%) as having either a psychological and/or situational triggers. Possible aetiologies were not identified by the PRD. Only six participants of the total sample underwent bedside assessment of which, three participants had abnormal VOR function. Compliance was low due to illness and other reasons and as a result only one participant was assessed with VNG and was found to have abnormal VOR function. Clinical and laboratory findings suggested the presence of mixed pathologies. Findings from self-assessment scales showed that majority (91%) of participants did not perceive vertigo as a problem (through the VSS) and 84% did not perceive their dizziness to be handicapping (through DHI).

Conclusion: Results showed high prevalence of dizziness in the adult HIV population and although no correlations could be made between patient report and clinical and laboratory findings, the potential use of a classification system was highlighted. The study would benefit from replication in a larger cohort of participants and obtaining clinical and laboratory results with which correlations to the case history can be made.

Key words:

Dizziness, dizziness classification, HIV, vestibular assessment, vestibular dysfunction

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Abbreviations

AIDS Acquired Immunodeficiency Syndrome

BPPV Benign paroxysmal positional vertigo

SCC Semi-circular canals

DGI Dynamic Gait Index

DHI Dizziness Handicap Inventory

ENG Electronystagmography

HIV Human Immunodeficiency Virus

MD Ménière's disease

PLHIV People living with HIV

PRD Patient Report Diagnosis

QoL Quality of Life

VN Vestibular neuritis

VNG Videonystagmography

VOR Vestibulo-ocular reflex

VSR Vestibulo-spinal reflex

VSS Vertigo Symptom Scale

Glossary

AIDS: Acquired Immunodeficiency Syndrome. A disease which is caused by the human immunodeficiency; which reduces the body's ability to defend itself against infections and diseases (UNAIDS, 2011).

Auditory: related to the sense of hearing.

Balance: control movements of the centre of mass relative to stability limits in order to maintain equilibrium and postural control. The integration of three input signals (visual, vestibular and somatosensory) and execution via motor output signals are required for balance to be maintained (Loader et al., 2007).

Bedside assessment: clinical assessment of the vestibular-oculo reflex, vestibular-spinal reflex, all cranial nerve functions, balance, gait and ocular function and visual acuity. Additional assessment includes Dynamic Gait Index which is a standardized test that assesses gait of a patient (Tamber et al., 2009). See Appendix 19 for details on tests.

BPPV: Benign Paroxysmal Positional Vertigo. A disorder of the labyrinth of the inner ear, which is characterized by vertigo and nystagmus when the head is moved in a certain direction (Chan, 2009).

Calorics: stimulation of the inner ear with water of 7° Celsius above and below body temperature (Fetter, 2010).

Case History Data: information about the patient regarding their medical and personal details, including a case history based on dizziness. See Appendix 19 for details and Appendix 5 for data collection form.

Central Compensation: neuroplasticity of the brain accommodates and adjusts for error signals (Mira, 2006; Hamid, 2010).

Central vestibular system: parts of the central nervous system (vestibular nuclei in the medulla, vestibular projections to the cerebellum, spinal cord & rostral brainstem) that process information from the peripheral vestibular system about balance and spatial orientation (Lowrie, 2012).

Dysequilibrium: unsteadiness, imbalance, or loss of equilibrium with movement; often accompanied by spatial disorientation (a sensation of not knowing where one's body is in relation to the vertical and horizontal planes) (Garcia, 2009)..

HIV: Human Immunodeficiency Virus that weakens the immune system of an individual which results to AIDS, as the body's ability to defend itself against infections and disease is weakened (UNAIDS, 2011). Antiretroviral medication is used to strengthen or maintain the immune system of a person who lives with HIV (UNAIDS, 2011).

Labyrinth: complex system of chambers and passageways of the inner ear; includes both the hearing and balance portions of the inner ear (Crossman & Neary, 2005).

Non-specific dizziness: dizziness that can be attributed to psychological disorders (Staab, 2008) or where the cause is unknown.

Nystagmus: involuntary, alternating rapid and slow movements of eyeballs. Nystagmus can be the result of peripheral and or central vestibular dysfunction (Schubert & Minor, 2004; Strupp et al.,

2011). Peripheral nystagmus is usually observed in patients with unilateral peripheral vestibular hypofunction (Schubert & Minor, 2004).

Oscillopsia: degraded vision during active head movements due to abnormal vestibulo-ocular reflex (VOR) function, often associated with bilateral vestibular hypofunction (Shepard & Schubert, 2008; Tilikete & Vighetto, 2011)

Peripheral vestibular system: parts of the inner ear concerned with balance and body orientation; consists of the semi-circular canals, utricle, and saccule (Crossman & Neary, 2005). Peripheral in the context of this study means outside the central nervous system (brain and brainstem), to which the peripheral system sends information (Lowrie, 2012).

PRD: Patient-Report-Diagnosis. A patient centred algorithm which was developed by the researcher to categorise the four types of dizziness, from the report of symptoms by patients.

Pre-syncope: sensation of light-headedness just before fainting (Bennett, 2008).

Saccades: corrective movements of the eye to maintain visual focus on a target (Yang, Bucci & Kapoula, 2002). Saccades are usually associated with unilateral peripheral vestibular hypofunction; nystagmus is usually observed as well (Shepard & Schubert, 2008)

Vertigo: the illusory sense of rotational movement of one's self or surroundings, accompanied with nausea and vomiting (Hofmeyr & Baker, 2010).

Vestibular Rehabilitation: an alternative form of exercise treatment designed to decrease dizziness, increase balance function and increase activity levels (Mira, 2006, Hillier & McDonnell, 2010).

Videonystagmography (VNG): clinical assessment of the vestibular-oculo reflex, vestibular-spinal reflex and ocular function. Conducted with computerised VNG equipment; computer, goggles and LED target. In essence VNG is a computerized clinical assessment of the vestibular system which provides quantitative and objective results (Shepard & Schubert, 2008).

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Introduction

People living with HIV/AIDS (PLHIV) experience a variety of symptoms, with dizziness being a relatively common manifestation in 30% of this population (Hofmeyr & Baker, 2010). Although almost a third of PLHIV report a dizziness experience, there is a lack of prevalence information (Heinze, Swanepoel & Hofmeyr, 2011); partly due to limited research on dizziness in PLHIV (Heinze et al., 2011) and the overshadowing of dizziness as a main complaint by a myriad of symptoms.

Although reports on prevalence of the symptoms of dizziness are scarce, the reports concerning the effect of HIV on anatomical structures and physiological functions of the balance systems have been published (Hausler, Vibert & Koralnik, 1991; Chandrasekhar et al, 2000). What is lacking, however, is the understanding between HIV related anatomical and physiological changes, and how these present as symptoms in a patient.

Recently however, studies exploring dizziness, have found that PLHIV do experience dizziness (Teggi, Giordano, Pistorio & Bussi, 2006; Teggi, Ceserani, Luce, Lazzarin & Bussi, 2008) even though the cause of the dizziness has not been established. Investigations by Teggi and colleagues (2006; 2008) have not determined how HIV or impacting factors such as medication or concomitant illnesses are related.

Drawing from recent literature, it is suggested that people living with HIV may indeed have dizziness as a complaint, though, there is a gap in the literature which needs to be addressed. This study will attempt to meet the need by investigating the prevalence of dizziness in the adult HIV population and the relationships that may exist between reported dizziness and vestibular function.

Chapter 1 will provide an overview of dizziness and vestibular dysfunction. Situating vestibular dysfunction within the dizziness spectrum and the implications for HIV will be discussed next. Post mortem otologic studies concerned with HIV/AIDS will be reviewed first, followed by studies concerned with otologic assessment in HIV/AIDS patients.

Dizziness will be explored by clarifying dizziness, discussing the systematic classification of vestibular dysfunction and evaluating the current approach to the assessment of vestibular dysfunction and the implications for HIV. Considerations on evidence-based management of the dizzy patient will follow.

Figure 1 below provides a visual layout of the chapter.

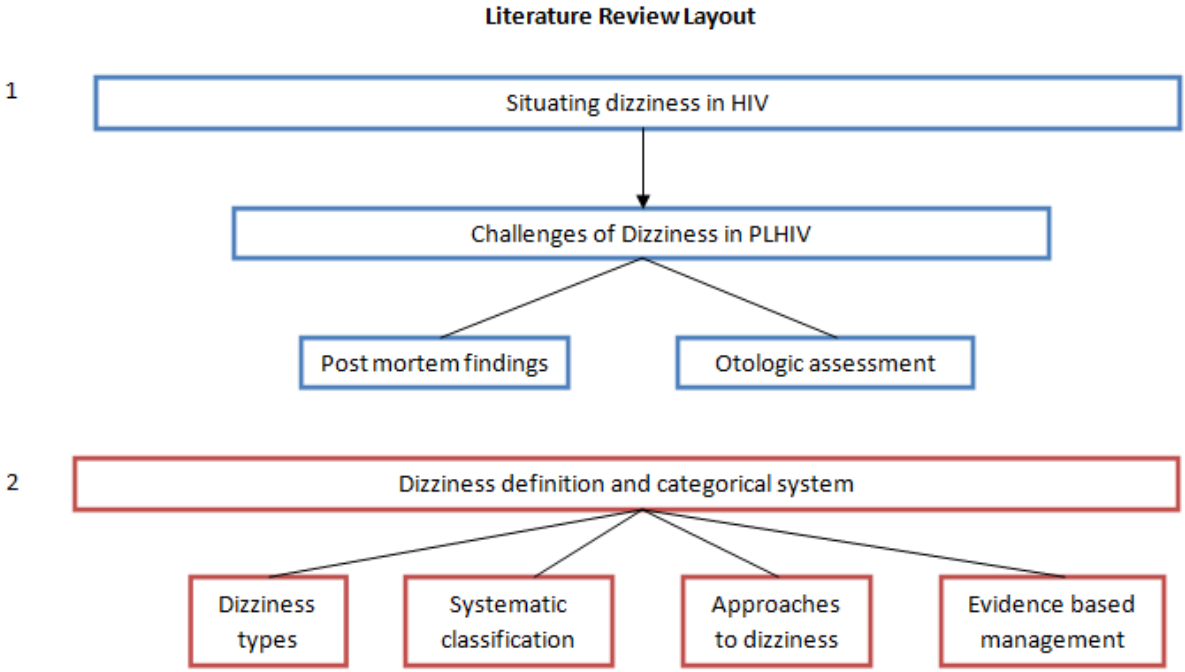

Figure 1: Chapter 1 layout

The rationale of the study, aims and objectives of the study will be presented at the end of the chapter.

Chapter Layout

- Chapter 1: Places dizziness in the HIV population through discussing previous studies and elaborates on the definition, characterization and diagnosis of dizziness in PLHIV.
- Chapter 2: Will discuss the differential diagnosis of dizziness by means of the algorithm that was developed by the researcher for the needs of the study.
- Chapter 3: Research methodology
- Chapter 4: Results
- Chapter 5: Discussion

CHAPTER 1

Situating vestibular dysfunction within the dizziness spectrum and the implications for HIV

Dizziness affects approximately 20% to 30% of the general population (Yardley, Owen, Nazareth & Luxon 1998; Chu & Cheng, 2007; Karatas, 2008) and predominates in several adult populations, such as the elderly (Garcia, 2009), people with panic and anxiety disorders (Wiltnik et al., 2009), Ménière's disease (Nadeau, 2008), migraine, stroke, cardiovascular diseases (Nadeau, 2008) and diabetes (Agrawal, Carey, Santina, Schubert & Minor, 2009; 2010).

Four types of dizziness exist in a spectrum, namely vertigo, dysequilibrium without vertigo, pre-syncope and non-specific dizziness. Although dizziness is related to general medical conditions, vertigo, the most severe of the dizziness types, has its root in the vestibular system (Bennett, 2008). Vertigo is defined as an illusory sensation of rotation or movement of either the surroundings or oneself (Marra, Wenchkin, Rees, Syapin & Gates, 1997; Hofmeyr & Baker, 2010). Vertigo has been reported in 30% of all dizzy HIV cases (Marra et al., 1997). Yet, prevalence data remains under described (Heinze, Swanepoel & Hofmeyr, 2011). The lack of prevalence data may be attributed to the scarcity of studies exploring dizziness and its subtypes in HIV populations (Heinze et al., 2011).

Although prevalence information is limited (Heinze et al., 2011), there is substantial information on the effect of HIV on the balance systems of the body. Prevalence estimates, which have been drawn from original research, are based on post mortem investigations where the damage to anatomical structures as well as physiological functions of the balance systems were recorded (Hausler, Vibert & Koralnik, 1991; Chandrasekhar et al., 1992).

One of the difficulties with the reports on anatomical and physiological changes is that they do not link symptom presence with diagnosis of underlying vestibular involvement in the post mortem cases. For example, a patient may report no symptoms whilst a VNG evaluation would detect a unilateral weakness (McCaslin, Dundas & Jacobson, 2008). When dizziness is suspected or presented the phenomenon is explored further, through case history taking, which is the fundamental part of diagnosis of vestibular dysfunction (Chawla & Olshaker, 2006). The case history despite providing valuable information regarding the patient's experience of illness, cannot evaluate physiological function. The complex relationship between symptoms and pathology therefore necessitates the use of supplementary measures in clarifying what is gathered by the case history. In order to substantiate case history information it is necessary to include physiological measures such as the clinical or bedside assessment and laboratory evaluations, the most widely used of which is videonystagmography (VNG) (Tusa, 2010). Due to the nature of vestibular disorders and vestibular compensation, the link between tests of physiological function, such as VNG, and patient report is variable (Heinze et al., 2011). For instance, patients may report no experience of dizziness, whilst their VNG would indicate dysfunction and vice versa.

Establishing the type and nature of dizziness via anamnesis is essential as it guides the clinician with regard to assessment (Bennett, 2008). The type of dizziness identified enables the clinician to choose tests that will provide the information needed for a diagnosis (Bennett, 2008). Clinical or bedside assessment may include tests of the vestibular-ocular (VOR) reflex, vestibular-spinal reflex (VSR), gait and possibly stimulation of the semi-circular canals (SCC) by means of water based convection currents (caloric irrigation) (McCaslin et al., 2008). Laboratory tests may also be

used in selected patients (McCaslin, et al., 2008). Laboratory tests may include VNG, which is used to record eye movements of the patient during the examination (Shepard, 2009). Caloric irrigation contributes two fold as it provides qualitative information at the bedside and quantitative information when conducted in the laboratory. The hearing status of a patient is an important factor in the diagnostic process and audiologic assessment provides additional information in certain dizzy cases (Brandt & Strupp, 2005).

Research in, and care for dizziness in the HIV population has its own challenges i) as there is limited knowledge on the prevalence of dizziness in the adult HIV population ii) how it presents both symptomatically and physiologically in the HIV population and iii) the possibility of dizziness being overlooked due to the milieu of conditions the HIV patient has and medication consumed.

Exploration of Challenges of Dizziness in PLHIV Populations

Dizziness is prevalent in approximately 30% of all dizzy HIV cases (Marra et al., 1997; Hofmeyr & Baker, 2010). Despite a reported third of the HIV population experiencing dizziness, there have been a limited number of reports on the prevalence and specific type of dizziness experienced by the HIV population (Heinze et al., 2011). The limited knowledge of prevalence and dizziness characteristics in the HIV population is variable and has limitations. Methodological downfalls, such as small study samples, biased selection of participants, absence of patient report and limited assessment batteries (Heinze et al., 2011) are some of the constraints of previous studies. With shortcomings in the design of previous studies, the presence of dizziness in the HIV population and the role of vestibular lesions in relation to symptoms cannot be considered as absolutely certain.

The studies that have contributed knowledge on dizziness in PLHIV are reviewed and presented as anatomical and physiological orientated studies and assessment orientated studies.

Post-mortem otologic studies concerned with HIV/AIDS.

Early publications on HIV/AIDS investigated the effect the virus had on otologic structures. Chandrasekhar et al., (1992) found post-mortem changes in the vestibular organs which they attributed to HIV infection. Changes such as precipitations in the endolymphatic and perilymphatic spaces and alterations to the neurosensory epithelium in the utricle and saccule were found (Chandrasekhar et al., 1992). Kohan, Hammerschlag and Holliday (1990) previously supported the findings by Chandrasekhar et al. (1992) in their computer tomographic study of HIV related otologic disease. The findings by Kohan et al. (1990) and Chandrasekhar et al. (1992) are problematic as pre-mortem information regarding symptomology was absent, which made it difficult to extrapolate the findings to the patients' experiences with regard to dizziness.

Subsequently, Pappas, Roland, Lim, Lai and Hillman (1995) found cellular abnormalities in the vestibular-end organs of HIV infected participants, via electron microscopy. However, pre-mortem information such as otologic disease or clinical findings was not available. Similarly, as with the Chandrasekhar et al. (1992) and Kohan et al. (1990) studies, no link could be made between the dizziness experience of the participant and the degree of function of their vestibular end organs.

Therefore, the lack of patient report does not provide a detailed picture of the prevalence of dizziness in HIV populations. Patient report is important, as mentioned earlier, patients may present as being symptomatic or asymptomatic regardless of their physiological function.

Otologic assessment oriented studies concerned with HIV/AIDS.

Numerous papers on vestibular function assessment have cited Hausler et al. (1991) as they were the first to utilise a thorough clinical examination in their investigation of neuro-otological function. Hausler et al. (1991) found neuro-otological abnormalities increased with progressive HIV infection stages. Despite having a test battery addressing neurologic and otologic facets of vestibular function, patient report of symptoms was not conveyed. In addition, no information regarding the medication regimen, including potentially ototoxic agents, was provided. The absence of medication information was a limitation of the study as medication could have affected the electronystagmography (ENG) results thereby negatively influencing the overall outcome of the study (Zapala & Brey, 2009).

Another study conducted by Chandrasekhar et al. (2000) evaluated otologic and audiological function in HIV positive adults. Chandrasekhar et al., (2000) reported 32% of their small sample (n=5) experienced dizziness as established by their otologic questionnaire and medical folder review. The description of the dizziness experienced by the sample was based on a questionnaire which could have been interpreted incorrectly, as it has been documented that patients have difficulty describing dizziness (Newman-Toker et al., 2007). In addition the questionnaire used in the study, was developed by the authors, which is a limitation as it is unclear as to whether it was subjected to reliability and validity measures.

Two studies from Italy by Teggi, Giordano, Pistorio and Bussi (2006) and Teggi, Ceserani, Luce, Lazzarin and Bussi (2008), have investigated dizziness in HIV positive populations. The 2006 study evaluated aspects of balance function by means of calculating first, the percentage of peripheral vestibular damage via ENG, bi-thermal calorics and second, the Dynamic Gait Index (DGI). The authors used the DGI to assess gait and the risk of falling of the participants. The results did not satisfy the aim of the study as percentages of the peripheral vestibular damage in the participants were not provided, but rather information about the ENG patterns in the sample. In addition no correlations were made between the DGI and the ENG and bi-thermal caloric findings. Rather correlations were made between the DGI and duration of infection. Despite Teggi et al. (2006) finding a linear relationship between the DGI and years of infection, different causes of vestibular damage other than labyrinth damage are suspected to affect the results, which were not considered in the report.

Teggi and colleagues' (2008) second study investigated vestibular function in HIV positive participants in comparison to HIV negative control participants. An assessment battery consisting of neurotological screening, tests for spontaneous, positioning and positional nystagmus, head shake and thrust tests, audiometric examination, ENG and bi-thermal calorics was utilised. The study found that central vestibular system damage was directly proportional to HIV infection and equal incidence of peripheral damage across the three stages of HIV infection. A pit fall of the study was its classification of participants into dizziness categories and inclusion criteria. Only results of participants in the first stage of HIV infection were compared. More critically, the participants of the study were limited to three categories of dizziness; light-headed, heavy-headed and subjective imbalance, suggesting that there may have been non-vestibular causes for their symptoms as these dizziness types are not true vertigo. Limiting inclusion of participants to the three categories was established by patients who reported chronic sensations of non-vertiginous dizziness, light and heavy headedness or subjective imbalance (Teggi et al., 2008). Categories such as vertigo and

dysequilibrium were absent and thereby reducing the overall reflection of vestibular function in the HIV population.

Despite different studies having evaluated the vestibular function neurologically, physiologically and anatomically, they have found similar findings, namely that HIV causes damage to the vestibular and related neurological structures and as infection progresses physiological function decreases. However, although the findings are similar, one common aspect is the absence of patient report. Patient report is important in understanding and linking clinical findings to management, in order to establish links between dizziness and its assessment.

Four Types of Dizziness

Dizziness can be classified into four sub-categories: (1) vertigo, (2) dysequilibrium without vertigo, (3) pre-syncope and (4) non-specific dizziness. Table 1 provides descriptions of each dizziness type.

Dizziness Type	Description
Vertigo	Illusory sensation of rotation and/or movement of either the surroundings or oneself (Marra et al., 1997; Hofmeyr & Baker, 2010).
Dysequilibrium	Sensation of unsteadiness whilst standing or walking (Garcia, 2009).
Pre-syncope	Sensation of light-headedness just before fainting (Bennett, 2008).
Non-specific	Dizziness that can be attributed to psychological disorders (Staab, 2008), side-effects of medication and metabolic unbalance (Branch, Barton, Aminoff, Deschler & Wilterdink, 2010).

Table 1: Description of dizziness types

The different types of dizziness are distinguished from each other by a case history, through asking specific questions (Kuo, Pang & Chang, 2008; Tusa, 2010). Types of questions would elicit a description of the symptom itself, the tempo and exacerbating factors and relieving factors (Ruckenstein, 1995; Sloane, Coeytaux, Beck & Dallara, 2001; Tusa, 2010). These questions allow the identification of a specific type of dizziness which is important for an accurate diagnosis to be made and appropriate management to be given.

Systematic Classification of Vestibular Dysfunction

With the subjective complaint of dizziness being classified into four sub-categories, it would be expected that there would be a classification system in place to categorize vestibular dysfunction. However, no standard system of classification exists but rather different diagnostic approaches of vestibular dysfunction (Dros et al., 2010; Kerber & Fendrick, 2008). Attempts have been made to establish guidelines to diagnose certain vestibular disorders such as Ménière's disease and benign paroxysmal positional vertigo (BPPV) but these are not systematic and are not applied globally (Kerber & Fendrick, 2008). In addition, the classification of vestibular dysfunctions is not simple due to overlapping symptoms and test outcomes between different pathologies (Dros et al., 2010; Kerber & Fendrick, 2008). Attempts have been made to categorise vestibular dysfunctions, by means

of patient report and related symptomology (Hoffman, Einstadter & Kroenke, 1999), physical and laboratory examinations (Clarke, 2010).

Each step of the differential diagnosis is important and critical however, not one of them can stand alone (McCaslin et al., 2008). Some cases are diagnosed through case history and physical examination and do not require laboratory evaluation, whilst others require the inclusion of laboratory examinations (McCaslin et al., 2008). The differential diagnosis is a symptom and pathology dependent approach which may enable quick diagnoses and other times is dependent on test results. The different types of approaches used to differentially diagnose vestibular dysfunctions are discussed below.

Symptoms oriented approach.

There is no universal acceptance of a symptom oriented approach, despite the most widely used approach or algorithm, is symptom based (Lee, 2012; Hoffman et al., 1999). The appeal of using a symptoms oriented approach is that it enables the differentiation between pathologies (based primarily on the main complaint and associated symptoms) and allows for a quick and relatively easy differential diagnosis to be made. Up to 75% of dizzy cases can be diagnosed and managed without further testing (Hoffman et al., 1999). For example; a history of acute onset of vertigo lasting days in duration with no otologic or neurotologic symptoms after an upper respiratory infection would most probably be diagnosed as vestibular neuritis (Tusa, 2010). The lack of otologic and neurologic symptoms allows the clinician to differentiate between vestibular neuritis from vascular events or Ménière's disease (Kuo et al., 2008; Tusa, 2010).

However, there are many limitations with the symptoms oriented approach such as precision and inclusion of symptoms into the algorithm (Kentala & Rauch, 2003). Usually symptoms oriented algorithms take on the appearance of tree diagrams. The tree diagrams follow a dichotic decision making process, which guides the user towards other symptoms and finally a pathology (Kentala & Rauch, 2003; Kuo et al., 2008; Zhao, Piccirillo, Spitznagel, Kallogogjeri & Goebel, 2011). Technology has been implemented in the symptoms oriented approach by means of decision tree induction which is computer based (Vikki, Kentala, Juhola & Pyykko, 1999; Vikki, Kentala, Juhola, Pyykko & Honkavaara, 2002). Even with the implementation of computerised systems, there are still limitations with symptom based approaches. The limitations arise with the increase of symptoms as the accuracy of the system fails (Vikki et al., 1999). In addition, special or rare cases cannot be diagnosed with decision trees (Vikki et al., 1999).

Test oriented approach.

A vestibular assessment is conducted and includes an audiological assessment, a VOR and VSR assessment, SCC tests, gait assessment and neurological examination (Fife et al., 2000; McCaslin et al., 2008; Post & Dickerson, 2010).

Each test in the assessment battery provides useful information about the vestibular system. Some of the tests in the protocol provide information about laterality of dysfunction, others about central versus peripheral location and the site of lesion within the vestibular system (Fife et al., 2000; Phillips, Mallinson & Hamid, 2011). However, the different tests are unable to provide an overall diagnosis and therefore, a test battery needs to be warranted, applied appropriately and in the right combination (Phillips et al., 2011). For example, the head thrust test is usually used in

conjunction with the caloric test as the two test the same area (lateral semi-circular canal) but differ in the frequency; head thrust test focusing on high frequency stimulation and the caloric test focusing on low frequency stimulation (Staab, 2008).

Technological advancements have led to the advent of computerised assessment. One computerised assessment is VNG, which is heavily reliant on normative data, clinician experience (Des Courtis et al., 2008) and software effectiveness (Gananca, Caovilla & Gananca, 2010). The VNG provides similar results to aspects of the clinical examination, but is more sensitive to minute responses and to the identification of nystagmus (Pietkiewics, Pepas, Sulkowski, Zielinska-Blizniewska & Olszewski, 2012). The VNG is able to detect minute nystagmus compared to a clinician but cannot reliably diagnose a symptom such as vertigo or if a patient has a vestibular dysfunction, based on the presence or absence of nystagmus (Jacobson, Shepard, Dundas, McCaslin & Piker, 2008).

While the assessment battery yields quantitative and qualitative information of varying quality on the functioning of the vestibular system, there is one downfall, which is the lack of patient report (Goebel, White & Heidenreich, 2009). A patient may have positive clinical findings, but may be asymptomatic and vice versa, which may be due to vestibular adaptation or compensation. Diagnoses made via clinical and laboratory assessments may be accurate from a medical perspective but may be inaccurate from a patient centred perspective (Karus et al., 2005). Tests may provide information about the structural integrity of the vestibular system, but may not be able to determine patient function (Yardley et al., 1998).

Due to the complex relationship between symptoms and clinical and laboratory findings, and limited sensitivity and specificity of the examination in the context of the dizzy or vertiginous patient, a diagnostic algorithm has been developed for the purposes of this study. Based on the patient centred perspective, the diagnostic algorithm will incorporate the patient, their dizziness experience and symptoms into one algorithm. The algorithm will be used as a new system towards classification of vestibular dysfunction and will be presented in Chapter 2.

Evidence-Based Management of the Patient

Regardless of which diagnostic approach is selected, information obtained from the patient's experience, case history, clinical and laboratory assessments is synthesized into an appropriate management strategy.

Management of patients typically focuses on symptomatic relief and treatment of illnesses (Strupp & Brandt, 2009). Medication is usually the medium used to control symptoms (Tusa, 2010). Dizziness in patients is managed by medication and rehabilitation (Tusa, 2010). Acute symptomatic relief is recommended and warranted in the early stages of most vestibular dysfunctions (Strupp & Brandt, 2009; Tusa, 2010). Medicines such as antihistamines, anticholinergics, diuretics, steroids, benzodiazepines, calcium channel and dopamine receptor antagonists and antiemetics are prescribed to approximately 70% of dizzy patients, regardless of their HIV status (Jayarajan & Rajenderkumar, 2003). Usually, a combination of an antihistamine and an antiemetic is used to alleviate symptomatic vertigo caused by acute vestibular dysfunction (Kuo et al., 2008).

Management with medication is valid and effective however can be detrimental to the prognosis of the patient in the long-term as prolonged use decreases natural compensation (Mira,

2006; Kuo et al., 2008; Hamid, 2010). Natural compensation (also referred to as adaptation) is the body's ability to recover on its own by adapting to vestibular problems (Boismer, 2009). Due to the detrimental effect of long-term vestibular suppressants, research has been conducted to find other ways to compliment or accelerate the compensation process (Dutia, 2010). Evidence suggests exercise-based programmes (such as those prescribed in vestibular rehabilitation therapy) that target the vestibular system and its central connections in the brain, are most effective (Yardley et al., 2004; Mira, 2006, Hillier & McDonnell, 2010). Vestibular rehabilitation is a specialized form of exercise-based therapy which eliminates or significantly reduces the symptoms of vertigo by stimulating the central nervous system (Shumway-Cook, 2011). Vestibular rehabilitation does not exclude medical management, but controls and carefully utilises the medicines when appropriate (Tusa, 2010).

The main aim of vestibular rehabilitation is to reduce symptoms and improve function of the patient. A quality of life (QoL) study by Yardley et al. (2004) showed that 67% of patients reported significant improvement in their QoL following vestibular rehabilitation in comparison to 33% of patients who received medical management. Patients living with HIV have been described to have a poor perceived QoL (Peltzer & Phaswana-Mafuya, 2008). Patients who experience vertigo have poor QoL (Neuhauser et al., 2008; Grauvogel, Kaminsky & Rosahl, 2010). Patients who are HIV positive and experience dizziness could have a worse QoL, and may respond to the vestibular portion of the rehabilitation programme.

Research Question

What is the prevalence of dizziness in adults living with HIV/AIDS and do their experiences correlate to clinical and laboratory assessment findings of their vestibular function?

Rationale of Study

The focus of this study is on dizziness and how it presents in the adult population living within the HIV spectrum. The purpose of the study was to establish new prevalence information about dizziness that exists in the HIV population and to explore possible relationships between symptom and clinical and laboratory findings.

Aims and Objectives of Study

The aim and sub-aims of this study are as follows:

Aim: Presence and nature of self-reproted dizziness in an adult population within the HIV spectrum and its relationship to vestibular dysfunction as established by clinical and laboratory examination.

Sub-aim 1: To describe and identify the presence and nature of dizziness (asymptomatic versus symptomatic) in participants with HIV, by self-report and case history, and through the application of the patient centered four type model.

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Sub-aim 3: To develop a patient-centered four type model to classify dizzy participants based on symptomatology of common balance disorders.

The aims will be discussed further in Chapter 3, and the system for framing the research question will presented in Chapter 2.

CHAPTER 2

A Critical Review of Current Strengths and Limitation in Patient-Centred Diagnosis: Introducing the Patient-Report-Diagnosis (PRD) Algorithm Mechanism

Chapter 1 described the current landscape and identified the need for a revision of the current decision making process for diagnosing dizziness. This section will present a revised algorithm towards classification of vestibular dysfunction proposed namely Patient-Report-Diagnosis (PRD) and explore the strengths and limitations in patient-centered diagnosis of vestibular related disorders.

Patient-centered diagnosis is a model which is relatively new in comparison to the medical model (Jayadevappa & Chhatre, 2011). Despite being a fairly new approach in medicine, the benefits of putting the patient at the centre of care have been found to outweigh the advantages of the medical model. By focusing on the person and not the body, patient-centered diagnosis has been shown to improve the outcomes of care as there are usually other problems in a patient's life other than the illness, which may well contribute or be the cause of their illness (Gustafson et al., 1999; Pelzang, 2010; Jayadevappa & Chhatre, 2011).

Focusing on the body and not the person when diagnosing an illness hinders the overall diagnosis and also has repercussion in terms of management and outcome (Bergeson & Dean, 2006; Jayadevappa & Chhatre, 2011). Therefore, the need, especially in diagnosing vestibular disorders, for a holistic view is important as some disorders which present as dizziness have their root in daily activities and personal circumstances of patients. For example, non-specific dizziness may be attributed to psychological disorders (Staab, 2008), side-effects of medication and metabolic unbalance (Branch, Barton, Aminoff, Deschler & Wilterdink, 2010) due to hypoglycaemia.

Patient-centered diagnosis has been found to have several advantages and fewer disadvantages than the common medical model. The advantages of the patient-centered diagnosis include increased trust in the clinician (Stewart et al., 2000; Bertakis & Azari, 2011), reduced anxiety felt by the patient (Jayadevappa & Chhatre, 2011; Bertakis & Azari, 2011), better understanding of the patient's complaint/s, needs and expectations as well as reduction in the number of diagnostic tests used by the clinician (Jayadevappa & Chhatre, 2011). In addition, patient-centered diagnosis facilitates holistic care, improves communication between health professionals and patients and their families (Ellis, 1999) and improves patient and clinician satisfaction (Epstein et al., 2005; Jayadeveppa & Chhatre, 2011). As with any paradigm, patient-centered diagnosis does have disadvantages, which include increased time and human resources (Gustafson et al., 1999; Pelzang, 2010) and the need to re-organise and/or restructure protocols in established settings (Pelzang, 2010).

With several advantages such as reduced anxiety felt by the patient and increased trust in the clinician, the process of gathering essential information is made possible and easier, depending on the skill of the clinician. Furthermore, the ability of patient-centered diagnosis being able to improve understanding of the patient's complaint/s, needs and expectations, information gathering is made more appealing than the medical model. With advantages of patient-centered diagnosis enhancing the process of case history taking, which is a cornerstone in the diagnosis of vestibular

disorders, the use of patient-centred diagnosis approach is well justified. Such an approach has been developed for this study and will be presented next.

The Patient-Report Diagnosis Algorithm Mechanism

The PRD is patient-centred and encompasses symptom-based diagnoses. The PRD approach intends to address the need for a differential diagnostic tool, as one does not exist at present. The function of the PRD is to provide an efficient way of systematically categorizing dizziness.

The PRD is presented as a model which can potentially be used as a systematic approach and the examples provided in this chapter are typical examples of aetiologies, and are not exhaustive. Clinicians will still require to rely on their knowledge, training and a thorough case history to make differential diagnoses. The PRD model may be used to navigate through thoughts on a conceptual approach to the dizzy patient.

The PRD will facilitate clinicians' diagnostic strategy by presenting the patient complaint at a starting point from which symptoms experienced by the patient will extend. The symptoms experienced by the patient will lead the clinician towards a diagnosis based on a specific type of dizziness as established by the patient complaint.

The PRD is comprised of five main aspects; nature of patient complaint, symptoms experienced by the patient, diagnoses, triggers of dizziness and possible referrals. The five aspects are depicted in Figure 2 and an overview of the whole algorithm is depicted in Figure 3. The aspects of the PRD are discussed below**.**

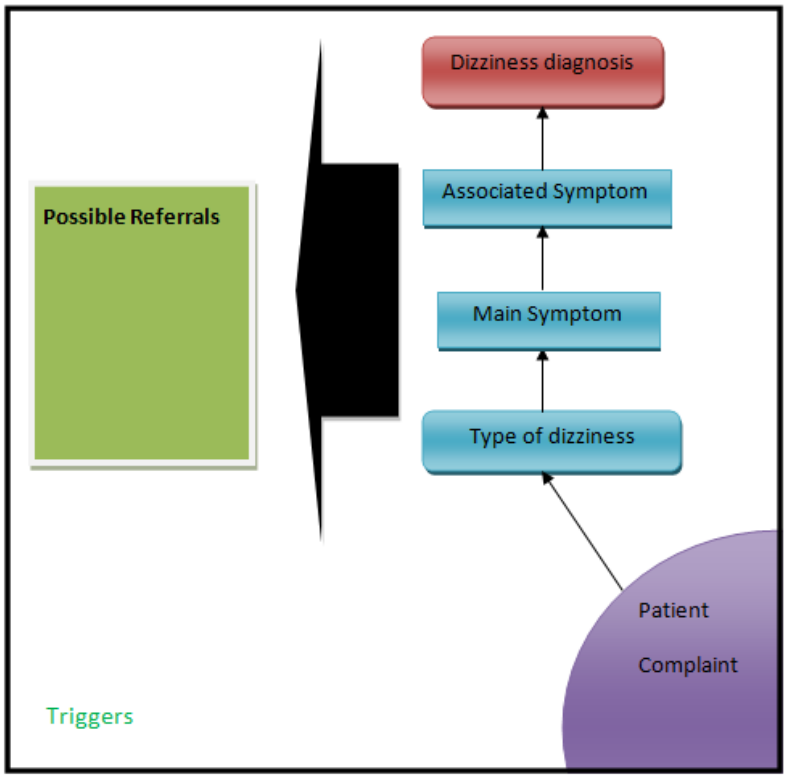

Figure 2: Patient-Report-Diagnosis basic layout. Purple = patient complaint, Blue= type of dizziness & symptoms experienced, Red= diagnosis of dizziness. , Green= triggers of dizziness

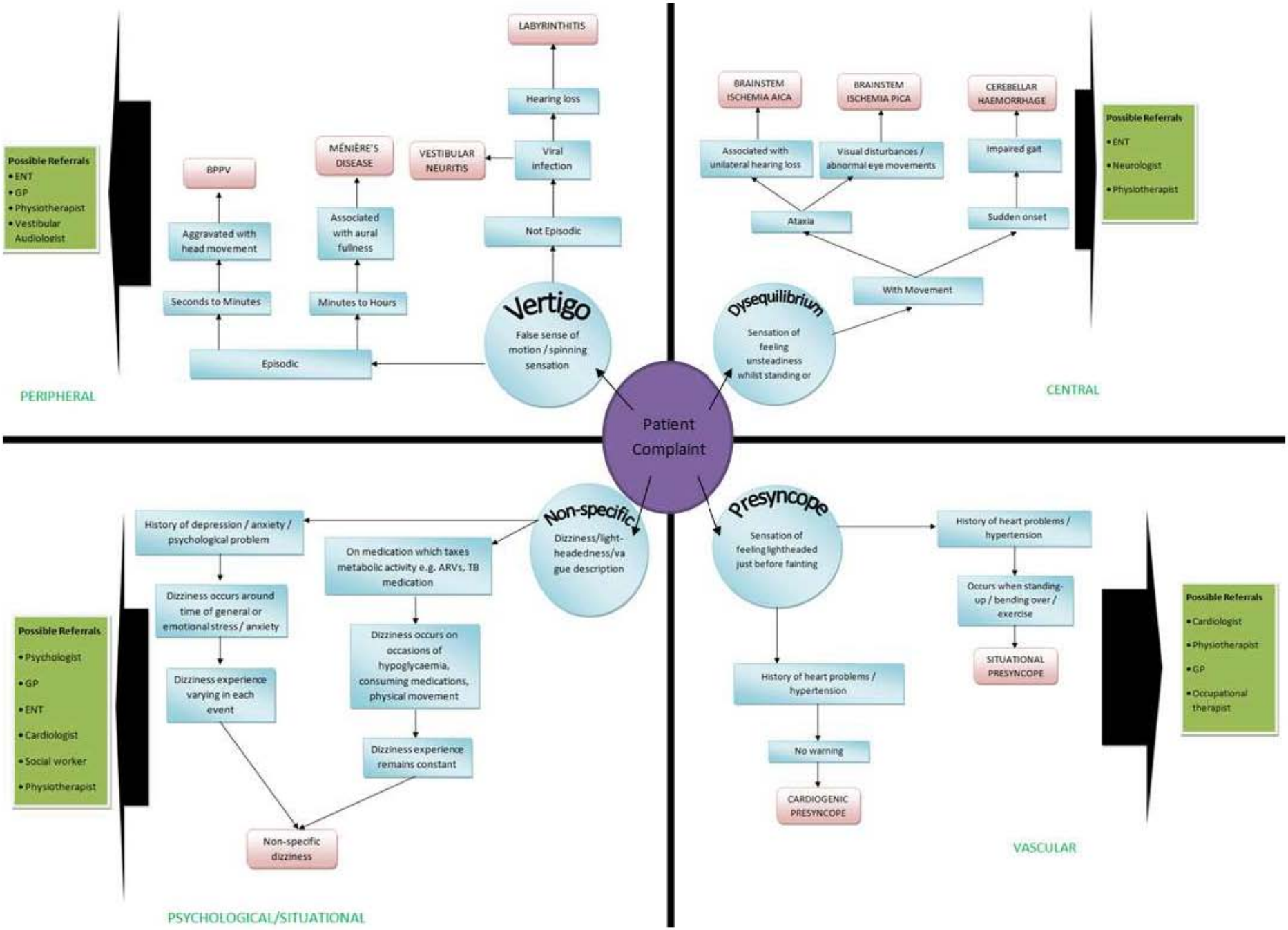

Figure 3: Overview of Patient-Report-Diagnosis algorithm.

Patient Complaint: Step 1

The patient's symptom is at the centre of the algorithm, as the information s/he provides drives the following steps in the diagnostic process by identifying the main complaint of the patient. It is here that differentiation of the four types of dizziness commences. For example, a patient who describes symptoms such as those associated with an impending faint is more likely to have pre-syncope rather than true vertigo, dysequilibrium or non-specific dizziness (Tusa, 2010).

The patient is the primary source of information about their clinical problem. The challenge is that patients often find it difficult to express their experience with dizziness (Tusa, 2010). Therefore, by tailoring the case history questions, it would become easier for patients to recall and describe their dizziness, as the questions are more specific and systematic (Post & Dickerson, 2010; Tusa, 2010). The information obtained from the patient regarding their dizziness, allows the clinician to refine the initial complaint of dizziness and categorise symptoms. Symptoms that occur together or in a certain sequence direct the clinician to a narrower range of possibilities. By narrowing the possibilities through clinical reasoning, a differential diagnosis can then be made with regard to the type of dizziness experienced by the patient.

Possible Triggers and Aetiologies: Step 2

Dizziness may be the result of dysfunction in different parts of the vestibular system (peripheral and central) (Chawla & Olshaker, 2006; Post & Dickerson, 2010), may have a psychological or situational basis (Staab & Ruckenstein, 2008; Branch et al., 2010) or may be due to vascular insufficiency (Karatas, 2011).

The four different categories of the PRD will be discussed on the following pages.

Peripheral section of PRD algorithm.

Dizziness categorised as peripheral by the PRD, has its origin in the peripheral vestibular system and is often described as vertigo. Common peripheral vestibular dysfunctions include BPPV, vestibular neuritis, Ménière's disease and labyrinthitis (Chan, 2009). Figure 4 below depicts the peripheral section of the PRD algorithm.

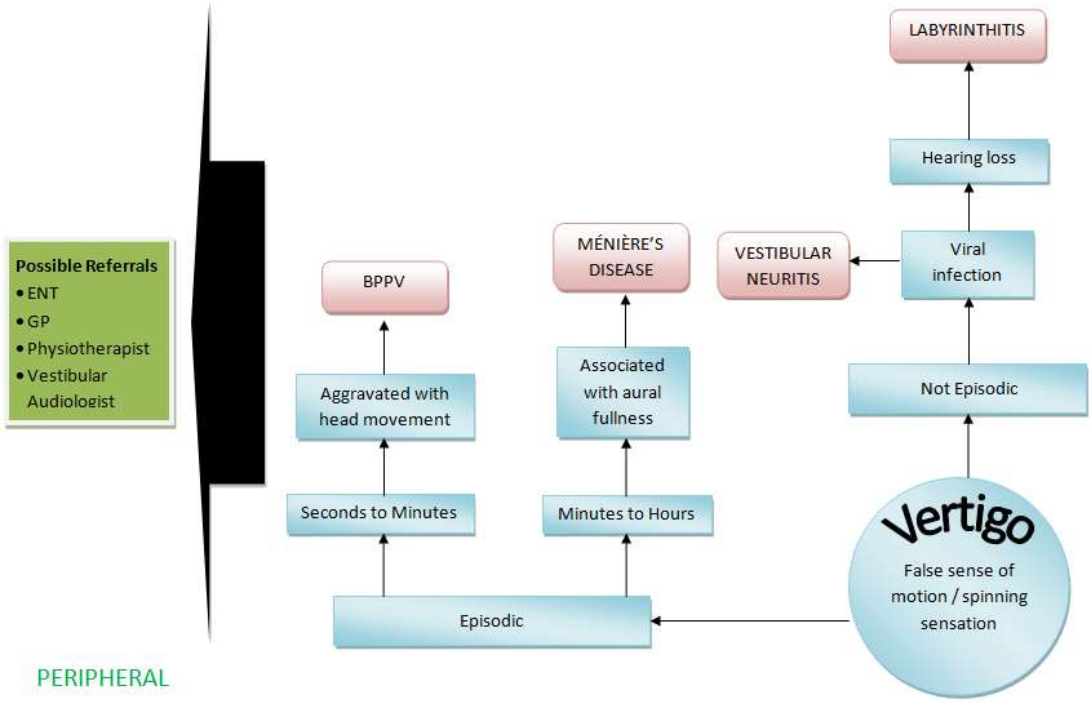

Figure 4: Peripheral section of PRD algorithm

As can be seen in Figure 4 a diagnosis is reached beginning with the patient report of a false sense of motion or spinning. The diagnostic process commences by establishing whether the vertigo is episodic in nature and how long the vertigo lasts. The specific questions about the duration and episodic nature of the vertigo, enables the clinician to narrow down the possible aetiologies (Chawla & Olshaker, 2006; Bennett, 2008; Tusa, 2010).

There are five diagnoses that are present in the peripheral section of the algorithm, as these are the most common diagnoses of vestibular dysfunction (Chan, 2009). The diagnoses that present as a single, prolonged episode are vestibular neuritis (VN) and labyrinthitis. Vestibular neuritis is often associated with a viral infection and has a sudden onset, with symptoms of nausea, vertigo, gait instability and lasts from days to weeks (Chan, 2009). Differentiation between VN and labyrinthitis rests on the presence of sensori-neural hearing loss which suggests labyrinthitis (Chawla & Olshaker, 2006; Kuo et al., 2008).

The vertigo experienced Ménière's disease (MD) is episodic in nature and lasts from minutes to hours (Chan, 2009). Classic MD symptoms include aural fullness and fluctuating sensorineural hearing loss (Chawla & Olshaker, 2006; Chan, 2009). Another diagnosis, which presents episodically but has a shorter duration, seconds to minutes, is benign paroxysmal positional vertigo (BPPV) (Bennett, 2008; Chan, 2009). BPPV is stimulated almost exclusively by head movement that occurs in daily activities such as turning over in bed (Chawla & Olshaker, 2006; Tusa, 2010).

Central section of PRD algorithm.

Dizziness categorised as being central may have its origin along the vestibular pathway (Dieterich, 2007). The components along the vestibular pathway include the vestibular nuclear complex, vestibulocerebellum, brainstem, spinal cord and vestibular cortex, as well as central parts of the vestibular system (Furman & Whitney, 2000; Karatas, 2008). Central vestibular dysfunctions include brainstem ischemia anterior inferior cerebellar artery (AICA) and posterior inferior cerebellar artery (PICA) and cerebellar haemorrhage. Only common disorders are depicted in the central section of the PRD algorithm, as the list is not exhaustive. Other pathologies such as bilateral vestibular hypofunction and ototoxicity may present as dysequilibrium rather than vertigo. Vertigo is an unlikely complaint with these pathologies due to their bilateral nature. While there are differences in the presenting complaints, features of the case history should allow for diagnosis of bilateral pathologies. Therefore, the necessity of a skilled clinician is warranted as well as patient report and history in the diagnosis of bilateral vestibular pathologies.

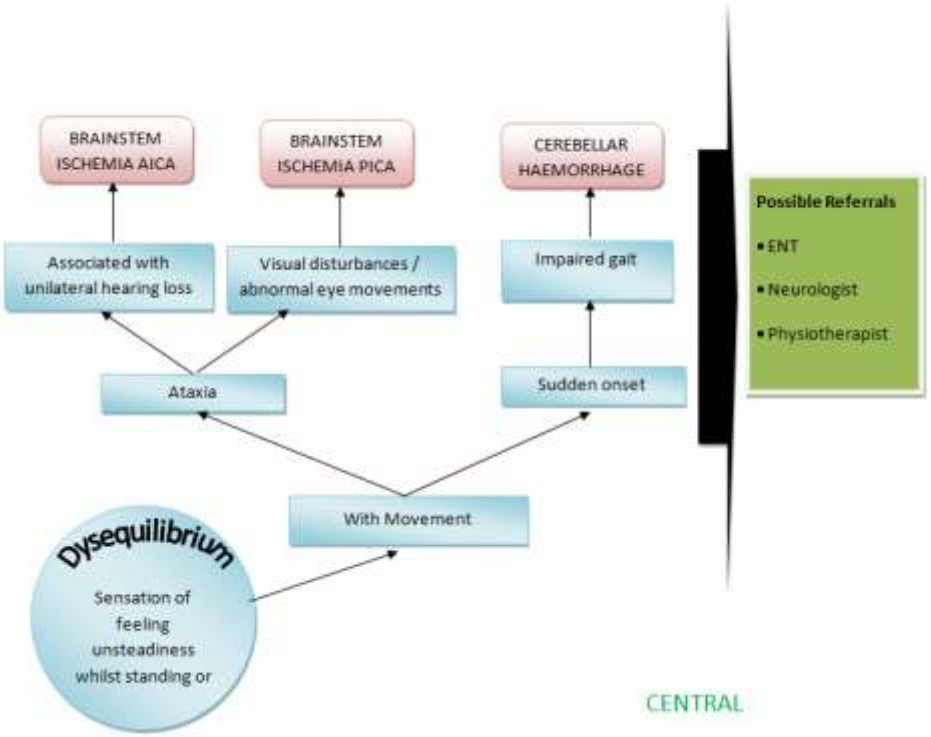

Figure 5: Central section of PRD algorithm

Figure 5 depicts how diagnosis is reached beginning with the patient complaint of a sense of feeling unsteady whilst standing or walking (dysequilibrium). The diagnostic process begins by establishing whether the dysequilibrium is associated with/out movement. Movement association is used in order to immediately differentiate between cerebellar involvement and brainstem ischemia (Furman & Whitney, 2000; Delaney, 2003).

There are three diagnoses that are present in the central section of the algorithm and are all associated with movement. Cerebellar haemorrhage has a sudden onset and is associated with impaired gait and severe vertigo (Olshaker, 2010; Crane, Eggers, Zee & Baloh, 2010). Although vertigo is a symptom with cerebellar haemorrhage, it is not the main complaint (Crane et al., 2010). Dysequilibrium which does not have a sudden onset may present with ataxia. The difference in diagnosis is established in the next step in the PRD, with the difference in symptoms (Crane et al., 2010; Ishiyama & Ishiyama, 2011). The two brainstem ischemiae, are differentiated by one being

associated with unilateral sensori-neural hearing loss (Crane et al., 2010; Karatas, 2011), which is identified as AICA; whereas PICA is associated with visual disturbances such as diplopia and abnormal eye movements (Crane et al, 2010; Ishiyama & Ishiyama, 2011; Karatas, 2011).

Other vestibular dysfunctions may be caused by ototoxicity which may affect the peripheral vestibular system, but may eventually cause central damage (Furman & Whitney, 2000). Ototoxicity may be caused by heavy metals such as mercury, lead and lithium, narcotic substances (Karatas, 2008) as well as aminoglycosides (Rogers & Petersen, 2011). Other causes may be old age as natural degeneration of organs, nerves and structures may result in vestibular dysfunction (Hansson, Mansson & Hakansson, 2005).

Vascular section of PRD algorithm.

Dizziness that is associated with blood perfusion insufficiencies are termed vascular by the PRD and the pre-syncope that results can be divided into cardiogenic and situational (Nadeau, 2008).

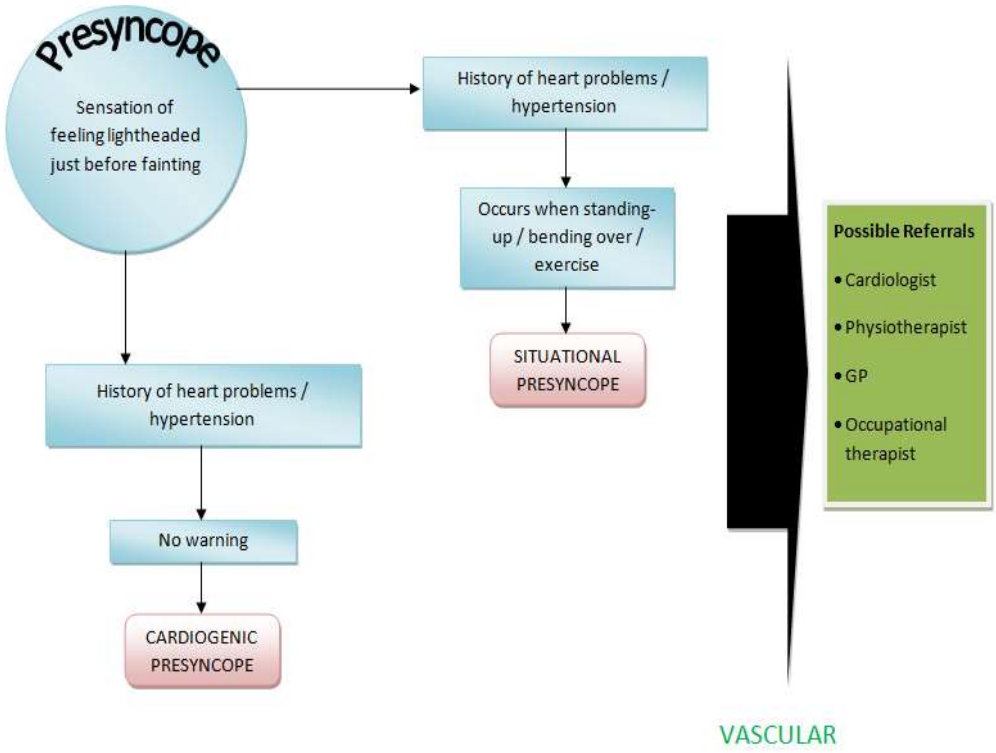

Figure 6: Vascular section of PRD algorithm

Cardiogenic pre-syncope may be due to cardiovascular diseases such as hypertension, stenosis of the aorta and arrhythmias (Nadeau, 2008; Lee, 2012). Situational pre-syncope (orthostatic hypotension) conversely is related to drops in blood pressure during daily activities (Delaney, 2003; Nadeau, 2008). The difference between the two is that situational pre-syncope is associated with postural movement such as bending over and standing up, whilst cardiogenic pre-syncope occurs without triggers (Nadeau, 2008).

Non-specific section of PRD algorithm.

Non-specific dizziness refers to dizziness that is not associated with physiological dysfunction but related to psychological disorders such as panic and anxiety disorders (Furman & Jacob, 2001; Bulbena & Pailhez, 2011) as well as side-effects of medication and metabolic unbalance (Branch et al., 2010). Patients who report varying experiences of dizziness and provide vague descriptions are usually categorised as having non-specific dizziness (Best, Eckhardt-Henn, Diener, Breuer & Dieterich, 2006), after vestibular testing has been conducted. In addition, patients who are on medications which tax the metabolic system (e.g. ARVs), may also have varying descriptions of dizziness experience (Branch et al., 2010). However, the situation or trigger of when the dizziness occurs, remains constant e.g. hypoglycaemia due to not eating (Branch et al., 2010). Therefore, the non-specific category is extended beyond the psychological cause of non-specific dizziness to the situational causes as well, as the literature shows that the origin of non-specific dizziness may not solely be psychological (Branch et al., 2010).

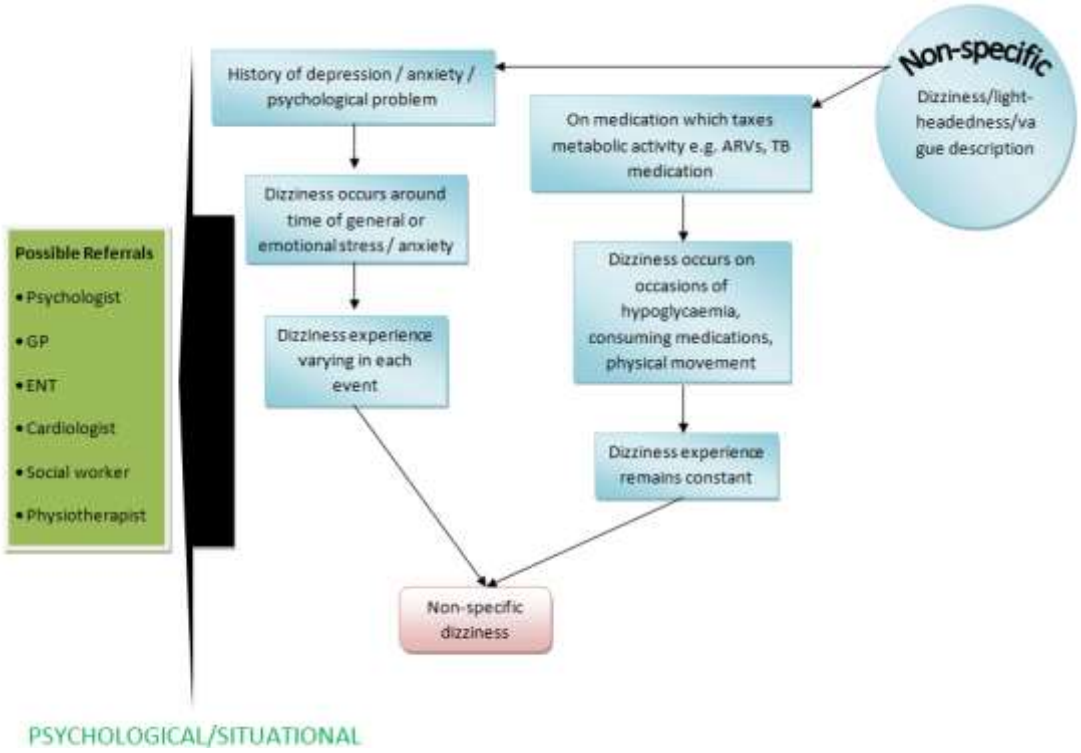

Figure 7: Psychological section of PRD algorithm

Summary of Chapter 2

This chapter introduced and discussed the mechanism of the Patient-Report-Diagnosis (PRD) algorithm that was developed for the purposes of the study. The basic layout and elements of the algorithm were explained and the four different types of dizziness and their related common diagnoses were explored.

CHAPTER 3

Research Methodology

Study Aims

Aim: Presence and nature of self-reproted dizziness in an adult population within the HIV spectrum and its relationship to vestibular dysfunction as established by clinical and laboratory examination.

Sub-aim 1: To describe and identify the presence and nature of dizziness (asymptomatic versus symptomatic) in participants with HIV, by self-report and case history, and through the application of the patient centered four type model.

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Research Design

A survey design using a quantitative descriptive approach was adopted for this study. A descriptive approach was used as it allowed for generalizations and observations to be established regarding dizziness (Johnson & Danhauer, 2002). The quantitative approach was chosen to enable correlations to be made between patient report and clinical findings (Monsen & Van Horn, 2008).

Participants

Thirty-two HIV positive participants were included in the study of which there were 14 males and 18 females, with a mean age of 37.3 years and a range from 29 to 52 years. Two participants were in stage I of HIV infection, 16 in stage II, seven in stage III and the remaining seven participants' infection stage was unknown; based on CD4 count stages of infection.

Study sample.

Explicit sample size calculations were not performed for this study, as the requisite information necessary for these calculations was either unavailable, or where available, suspected to be inaccurate. The sample size was thus determined by the practical limitations of the study and a non-probabilistic purposive sampling strategy was used. The final sample consisted of all participants meeting the inclusion criteria in the nine month period available to the researcher for data collection. This method is not unusual or undocumented, and was used by other researchers (Kohan et al., 1990; Soucek & Michaels, 1996; Khoza & Ross, 2002) who had 18, 150 and 155 participants in their samples respectively.

Inclusion criteria.

- All (adult) patients who were between the ages of 18-60 years of age, who were HIV positive as documented in their medical folders and attended the HIV clinic.
- Patients who gave informed consent to participate in the study.

Exclusion criteria.

- Children under 18 years of age were excluded as they are considered a vulnerable group (Medical Research Council, 2001; Aiter & Richer, 2005); and as dizziness and episodic vertigo is uncommon in children (McCaslin, Jacobson & Gruenwald, 2011; Balatsouras, 2007).

- Pregnant women were excluded as they are a vulnerable group (MRC, 2001).

- Participants with cognitive difficulties, established by the Clock Drawing Test (Schulam, 2000), were excluded. HIV/AIDS has been associated to cause cognitive decline (Nath et al., 2008) and therefore, PLHIV with cognitive difficulties are considered a vulnerable group (MRC, 2001). Cognitively impaired individuals would not be able to participate in the consent process, would have difficulty recalling symptoms and completing the self-assessment scales (Nath et al., 2008). Obtaining proxy consent was not considered to be appropriate for this particular study.

- Participants who reported feeling ill, or who were observed to be acutely ill on the day of interviewing were excluded in order not to cause undue distress or discomfort.

- Patients who reported to have previous ear, head or neck surgery were excluded as vestibular and/or neurological damage could have resulted from the surgery (Gans & Yellin, 2007).

- Participants who had persistent (longer than two weeks) middle ear infections or effusions, following repeated medical treatment (Babb, Hilsinger, Korol & Wilcox, 2004; Harris, Hutchingson & Moravec, 2005). Air filled ears were required for accurate caloric responses to be obtained (Fetter, 2010).

- Participants who received treatment for vertigo and/or dizziness within the preceding 14 days were excluded. A washout period was implemented as vestibular suppressants such as Betahistine, piperazine, Dimenhydrinate, Clonazepam, Diazepam, Lorazepam, Granisetron, Metoclopramine, Ondensetron, Prochloroperazine, Promethazine, Buclizine and Cyclizine reduce vestibular responses (Brandt, 2003; Desmond, 2004; Ackely, Decker & Limb, 2007).

- Participants who used an ambulatory device such as a crutch, wheelchair, walker, cane or lower limb prostheses were excluded, as some tests in the assessment battery required the participants to walk, step over obstacles and climb stairs.

- Participants who were above the age of 60 years were excluded as vestibular reflexes have been shown to decline with age (Matheson, Darlington & Smith, 1999).

- Participants who reported to have received recent eye surgery or surgery that affected eye movement were excluded as unaffected eye movements were required for VNG assessment (Gans & Yellin, 2007).

Recruitment.

Participants who were attending two HIV clinics were regarded as potential participants.. Nurses and doctors at the HIV clinics were incorporated into the recruitment process, as they directed patients to the researcher for possible inclusion into the study. Posters were also put up in the waiting rooms and talks regarding the study were also given in the waiting rooms, so as to increase recruitment of participants. Participants were provided with information regarding the nature and purpose of the study before informed consent (Appendix 1) was obtained (Appendix 2-4).

Data Collection Sites

Data was collected from two HIV clinics at one secondary and one tertiary hospital located in urban Cape Town. Data was collected once weekly at each institution's HIV clinic over a nine month period.

Data Collection Material

Demographic and medical data were gathered from the participants themselves and by folder review. An assessment battery was then administered to the participants. The five instruments were a case history data sheet (Appendix 5), two self-assessment scales (Appendix 6-11), a clinical bedside assessment sheet (Appendix 12) and a VNG system. The researcher conducted the folder review, participant interview including case history, clinical and laboratory examination. The laboratory examination was facilitated by the use of an Otometrics ICS Chartr 200 (see Appendix for details 13 & 14). Results were collated on to an Excel spread sheet.

The PRD algorithm was another tool used in the study to categorise the dizzy participants in the study based on the reported symptoms, to identify possible triggers of dizziness and identify possible aetiologies.

The different instruments used to conduct the study will be introduced and their use will be commented upon below.

Case history data sheet.

The case history data sheet was designed by the researcher. The data sheet was designed to capture the participant medical history and dizziness experience. The items included into the data sheet were based on established clinical practices in the determination of the nature of dizziness. Items such as onset of dizziness, duration, nature of dizziness and associated symptoms, self-reported hearing status and antiretroviral regimen and other medical problems were included in the data sheet.

Self-assessment Scales.

Two self-assessment scales were used to evaluate participants' dizziness experiences and are detailed below.

Vertigo Symptoms Scale.

The Vertigo Symptom Scale (VSS) (Yardley, Masson, Verschuur, Haacke & Luxon, 1992; Yanik et al., 2008) is a self-assessment scale that provides the clinician with information about the participant's perceived severity and frequency of vertigo and associated symptoms (Tamber, Wilhelmsen & Strand, 2009). The VSS has two sub-scales; vertigo and autonomic arousal by anxiety,

which have a five point scale to score the responses on the VSS. The maximum of the vertigo subscale is 76 and 60 for the anxiety sub-scale. Five to ten minutes are required to complete the VSS (Tamber et al., 2009).

Dizziness Handicap Inventory

The Dizziness Handicap Inventory (Jacobson & Newman, 1990) is a self-report questionnaire that is designed to evaluate the physical factors, functional and emotional consequences that are associated with dizziness, vertigo and unsteadiness (Jacobson & Newman, 1990). The DHI is scored out of a 100, with a higher score indicating greater handicap; 0-30 mild, 31- 60 moderate and 61-100 severe (Treleaven, 2006). The handicap rating (mild, moderate and severe) corresponds with the International Classification of Functioning, Disability and Health impairment classification scale (WHO, 2001).

Both scales have research validated translations (Rogers et al., 2011) into Afrikaans, the most commonly spoken language in the Western Cape (Statistics South Africa, 2007).

Clinical bedside assessment.

A data collection sheet was designed by the researcher based on established clinical bedside tests that evaluate the vestibular-ocular and vestibular-spinal reflex as well as nystagmus. The assessment protocol was collated by the researcher as there are no standardized protocols prescribed by audiological authorities. The materials used in the bedside assessment included the following:

- Otoscope: Welsh Allen 3.5v diagnostic otoscope.
- Audiometer: annually calibrated Grason Stadler GSI 61 audiometer.
- Sound treated booth.
- Tympanometer: an annually calibrated Grason Stadler TympStar Version 2.
- Examination couch with fresh linen.
- Frenzel's glasses: Dr. Blessing Type 711.
- Cotton wool balls.
- Foam platform: high density foam 7.62cm x 50.8cm x 50.8cm.Compression of 31.75Kg.
- Stop watch: Diesel model DZ 7557.
- Posey Gait Belt #6537DX.
- Small plastic traffic cones.
- Staircase with hand rail.

Videonystagmography (VNG).

A GN Ototmetrics ICS Chartr 200 VNG system (see Appendix 2.7 for photograph) was used in conjunction with an Otometrics ICS NCI-480 water irrigator. The following tools and materials were used to obtain evaluate the vestibular-ocular reflex and nystagmus:

- Distilled cold and warm water: cold water (30° Celsius) warm water (44° Celsius).
- Temperature thermostatically maintained by water irrigator; ICS NCI-480 water irrigator.
- VNG goggles: GN Otometrics ICS Chartr 200.
- Examinations couch with fresh linen and towels.

Patient-Report-Diagnosis Algorithm (PRD).

The PRD algorithm was used to categorise dizzy participants identified by the case history into the four types of dizziness based on the symptoms reported by the participants. Other aspects identified by the PRD were possible aetiologies and triggers of dizziness, which were established by the algorithm.

Data Collection Procedure

After clearance from the Human Research Ethics Committee of the University of Cape Town (Reference number; 458/2011 see Appendix 15) and the clinical sites concerned (see Appendix 16), data collection commenced; approval for one of the sites was obtained as a result of approval from Human Research Ethics Committee of the University of Cape Town and the other was obtained via verbal approval from the hospital's superintendent. Data were collected over a nine month period, once a week at each HIV clinic at the two research sites. The data were obtained using the materials mentioned above and informed consent was obtained from the patient prior to inclusion. Informed consent was recognised as an on-going process and was re-negotiated on each occasion. The data collection process is presented in Figure 9 below and the detailed procedure is presented in Table 2.

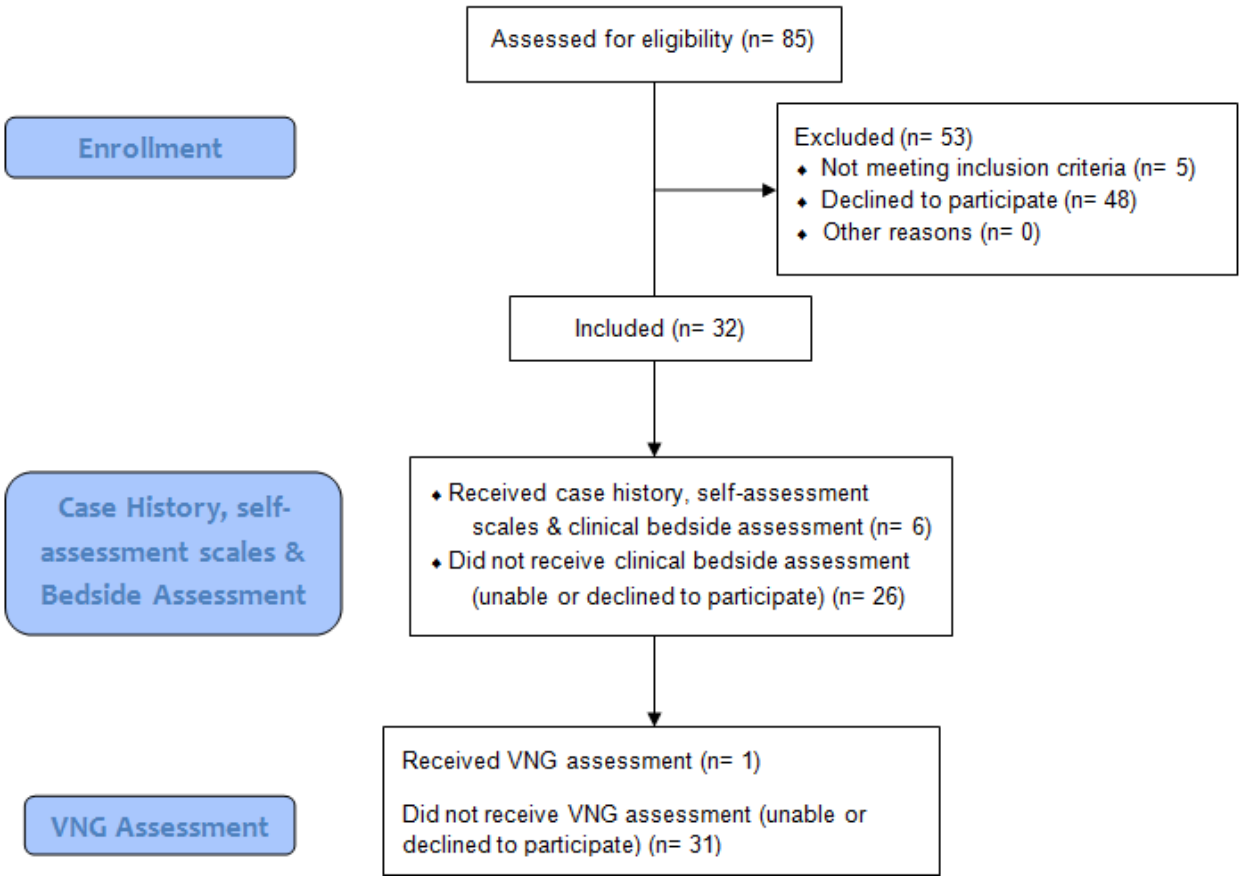

Figure 8: Flow chart of progress of participants through the assessment protocol

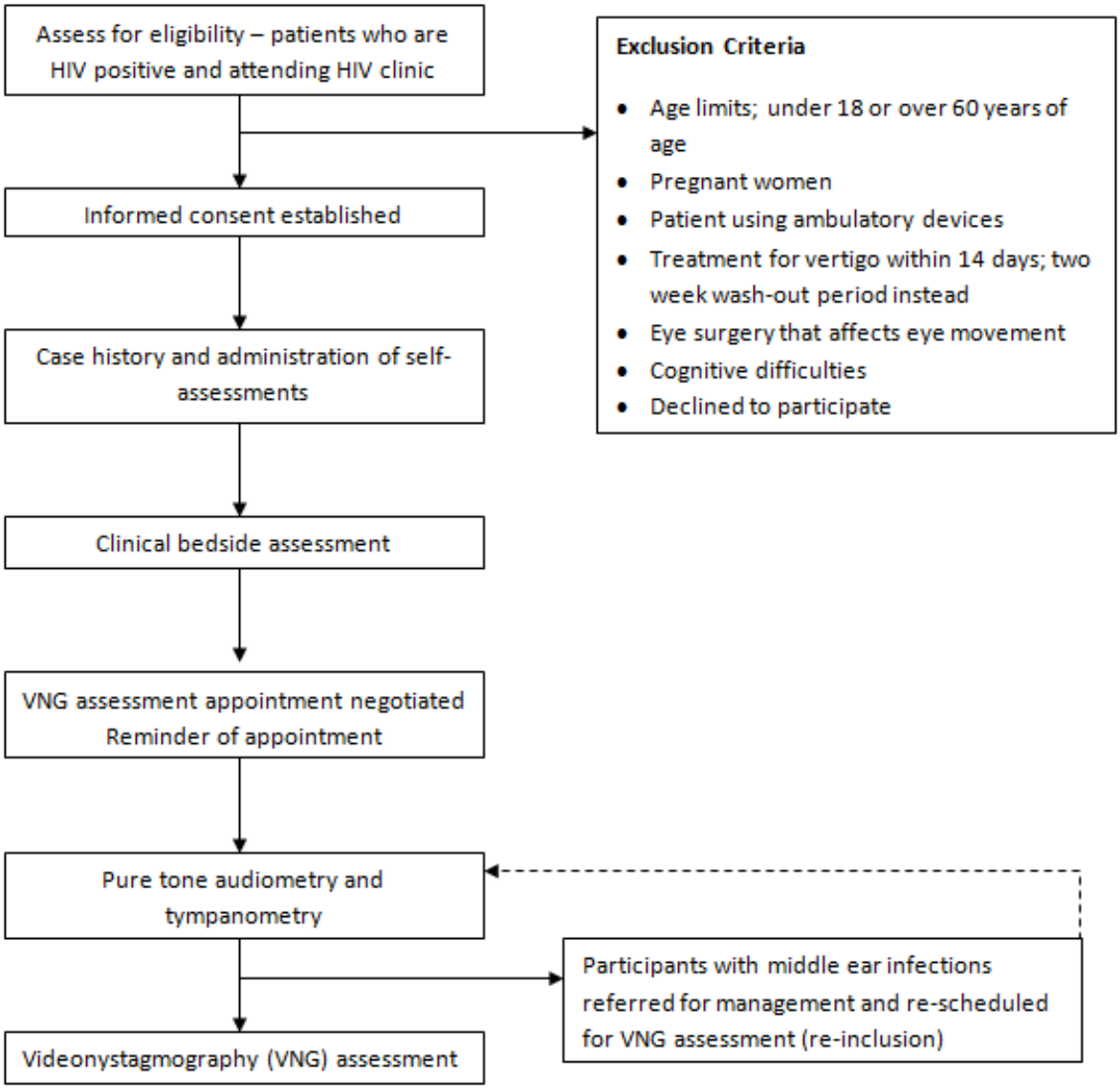

Figure 9: Data collection procedure flow chart

Chronological Procedure	Details	Data Tool
A. Consent obtained from participants	Informed consent obtained from patients attending HIV clinic. Participant selection criteria applied and patients not suitable were excluded. Study explained and informational letter given. Study explained and alternate signature obtained for illiterate participants.	Informed consent sheet and patient information letter (Appendix 1-4)
B. Case history	Participant demographic and case history details recorded on data sheet. Demographic details were obtained from the participants' medical folders. Case history was obtained verbally.	Case history data sheet (Appendix 5)
C. Self-assessment	Self-assessment scales were administered to participants beginning with VSS followed by DHI. Verbal responses were obtained for illiterate participants.	Vertigo Symptom Scale (Appendix 6-8) and Dizziness Handicap Inventory (Appendix 9-11)
D. Bedside Assessment	The clinical bedside assessment of vestibular function was conducted and responses of the participants were recorded on the data sheet. The bedside examination included the following tests (See Appendix 19 for each test's details), in order of administration sequence: 1. Spontaneous nystagmus 2. Gaze nystagmus 3. Range of eye movements 4. Smooth pursuit and saccades 5. Cranial nerves testing according to scope of practice 6. Dynamic Visual Acuity 7. Head Thrust 8. Head Shake 9. Hyperventilation 10. Cerebellar tests; finger-to-nose, heel-to-shin, supinating and pronating 11. Dix-Hallpike manoeuvre with vestibular adaptation and substitution therapy where necessary 12. Dynamic Gait Index (Appendix 21) 13. Romberg test standard and sharpened; both eyes-open and eyes-closed for each scenario 14. Modified Clinical Test of Sensory Organization and Balance (m-CTSIB)	Bedside assessment sheet (Appendix 12)
E. VNG consent	The researcher verbally explained the VNG tests to the participants and ensured they understood. Verbal re-consent was obtained from the participants.	
F. Reminder	Participants were reminded of their appointments one week and then two days before their appointment via SMS and phone calls in some cases. Participants were reminded to adhere to the preparatory instruction (Appendix 17) for the VNG assessment.	

G. Audiologic & VNG assessment	Before VNG was conducted, adherence to the preparatory requirements was checked with the participants. Participants were reminded that consent was a continuous process.	
G.1. Otoscopy and tympanometry	Otoscopy and tympanometry was conducted on the participants. Ear canal status and tympanometry (Appendix 19 for details) results were recorded on the bedside assessment sheet. Participants who failed G. 1. were referred for management and were given a chance to re-enter the study after management.	Bedside assessment sheet (Appendix 12)
G.2. Audiometry	Participants who passed G. 1. underwent pure tone audiometry. The Carhart-Jerger method of threshold determination was used (Carhart & Jerger, 1959; British Society of Audiology, 2004). The results of pure tone audiometry were categorised using BSA (2004) scale. Results were recorded on the bedside assessment sheet.	Bedside assessment sheet (Appendix 12)
G. 3. VNG assessment	Participants were given a five minute break after audiometry. The participants were then explained the procedure of the VNG and what was expected of them. Responses were recorded by the VNG computerized equipment. Caloric testing (Appendix 13 for details) began with cold water irrigation and a five minute break between ears (Fetter, 2010). A fifteen minute break was given to the participant before warm irrigation.	VNG equipment (13 & 14)

Table 2: Detailed data collection procedure with data collection tools

Data Management

Data captured was saved on a USB external hard drive (only one), of 500GB capacity, which was kept secure via password access. Back-up copies of the data were made on CD to prevent data loss and were kept secure in a locked drawer.

Participant identity was numerically coded. E.g. participant name: John Doe, Hospital Identity: 123456789. Coded participant identity: ABC001. Coding was used to ensure participant anonymity. Only one list was made and was kept in a secure location.

Data Analysis

The gathered data were entered into a Microsoft Excel spread sheet and was then imported into the statistical software, Statistica 10 from which statistical analyses were made. A p-value of <0.05 was regarded as statistically significant as a p-value of 0.01 would too stringent as the sample was small (Tredoux & Durrheim, 2006). Descriptive and correlation statistics such as Kruskal-Wallis, Bonferroni, Pearson-Chi squared and Fisher's exact tests were used to analyse data.

The Kruskal-Wallis test was selected as it allows for differences between variables to be established (Peacock & Peacock, 2011). The Bonferroni adjustment test was chosen as it allows to compare one group to the others and to determine which group is different (Peacock & Peacock, 2011). However, as the number of tests increases (groups compared to other groups) the likelihood of a Type 1 error also increases. The Bonferroni adjustment test allows to ensure that the data do not appear to be significant when they are not, which is why it is a suitable test in this study. The Mann-Whitney test was conducted as it is able to establish which of two variables is more significant (Peacock & Peacock, 2011). Fisher's exact test was used as it is capable of determining exact

significance of association between categorical variables and is suitable to use in small samples, which is the case in this study (Peacock & Peacock, 2011).

Research Personnel

The primary researcher and one supervisor were involved in the data collection process. Auxiliary personnel were required in the capacity of translators, for some instances of data collection where the participant was not competent in English. Other auxiliary personnel included doctors and nurses on duty, who served on an ad hoc basis should medical support be required. However, such assistance was not required during the course of the study.

Reliability

Reliability refers to the extent to which the results are consistent over time (Golafshani, 2003). In this study inter- and intra-rater reliability was implemented, which was established by re-evaluating 10% of the sample's data. The methods by which reliability of the data collection materials was maintained or checked will be discussed below.

Case history data sheet.

Random numbers were used to identify points for reliability check to be made. The researcher used a voice recorder to re-analyse case history information to check intra-rater reliability. The equation %reliability = [(agreements) / (disagreements + agreement)] * 100 was used to calculate the consistency of agreement of the researcher's identification of dizziness (Johnson & Danhauer, 2002). Intra-rater reliability was found to be 98%.

Translation of data collection materials.

Structured sentences were used to ask questions during case history taking and administration of self-assessment scales, to maintain standardised method and to allow replication of the study.

Self-assessments.

Reliability of the DHI has been shown to be high (Jacobson & Newman, 1990), its internal consistency had been documented to be 0.91 and its test-retest reliability to be 0.97 (Jacobson & Newman, 1990). The VSS has been shown to have a good test-retest reliability of 0.94 (Yardley et al., 1992).

Reliability of the DHI and VSS was maintained by administering them in the prescribed manner. The inability of participants to complete the self-assessments by themselves would have affected reliability. To address the threat to reliability a word-for-word administration was used in some cases.

Bedside assessment.

Inter-and intra-rater reliability was expected to be established, however, due to recording equipment malfunction, inter- and intra-rater reliability was unable to be assessed.

VNG assessment.

Inter-rater reliability was assessed through the interpretation of video recordings of the one patient evaluated with VNG. The equation %reliability = [(agreements) / (disagreements +

agreement)] * 100 was used to establish reliability. Inter-rater reliability was not required as no participant underwent full VNG assessment.

Patient-report-diagnosis algorithm (PRD).

Reliability of the PRD was maintained by using the definitions of dizziness as described in Chapter 1. Dizzy participants' descriptions were matched to the definitions of the four types of dizziness and then placed accordingly into the different categories of the PRD.

Validity

Validity refers to whether a research measure evaluates what it was designed to measure or how accurate the research results are (Golafshani, 2003). Face or content form of validity accurately measures the desired phenomenon occurrence (Johnson & Danhauer, 2002). Validation obtained through face or content, construct and criterion-related validity for the data collection material in the study will be discussed below.

Case history data sheet.

Content and construct validity applied to the case history data sheet. Content validity was ensured as the items on the sheet were drawn from established dizziness case history procedures that have been used for differential diagnosis and evaluation, by audiologists and otorhinolaryngologists (Broomfield, Bruce, Malla & Kay, 2008; Kerber, Fendrick, 2008; Shepard, 2009). Construct validity was present as the sheet allowed for descriptions and categorizations of sets of data into different types of dizziness to be made (Babbie & Mouton, 2007). In addition two experienced audiologists with post-graduate training in vestibular assessment and management were consulted for their opinions on the assessment instruments.

Self-assessment scales.

The DHI has been shown to have acceptable concurrent validity with other balance assessments such as the Dynamic Gait Index (Cattaneo, Regola & Meotti, 2006). The translated Afrikaans VSS has shown to have concurrent validity (Rogers et al., 2011), as well as the DHI (Rogers, unpublished data, 2011).

Bedside assessment sheet.

Content, construct and criterion-related validities applied to the tests within the bedside assessment. Content validity was ensured as the items in the sheet were drawn from established vestibular bedside assessment procedures that have been used for evaluation, by audiologists and otorhinolaryngologists (Broomfield et al., 2008; Kerber & Fendrick, 2008; Shepard, 2009). Content validity was present as the tests within the bedside assessment evaluated vestibular function as intended. Construct validity was relevant as the tests within the assessment enabled the description of sets of data and categorisation (Babbie & Mouton, 2007) of different vestibular dysfunctions.

Patient-report-diagnosis algorithm (PRD).

Content and construct validity applied to the PRD. Content validity was ensured as the symptoms in each dizziness category were drawn from common vestibular and dizziness related aetiologies as established by literature (Furman & Whitney, 2000; Best et al., 2006; Chawla & Olshaker, 2006; Dieterich, 2007; Nadeau, 2008; Karatas, 2008; Staab & Ruckenstein, 2008; Chan, 2009; Crane et al., 2010; Post & Dickerson, 2010; Tusa, 2010; Branch et al., 2011; Karatas, 2011; Lee,

2012). Construct validity was present as the algorithm allowed for descriptions and categorizations of dizziness symptoms reported by dizzy participants to be made (Babbie & Mouton, 2007).

Ethical Considerations

Consent to conduct the study was obtained from the Human Research Ethics Committee of the Faculty of Health Sciences of the University of Cape Town (Appendix 15). Permission was also obtained from the medical superintendents of the hospitals at which the study was conducted (Appendices 16 & 18).

The issues of confidentiality, autonomy, beneficence, non-malfeasance and justice (Belmont Report, 1979) were taken into consideration in the study and are detailed below.

Autonomy.

Autonomy of the participants was ensured via continuous informed consent, as this allowed "*protect the ability of the human being to choose for themselves and to determine their own course of life*" (Aita & Richer, 2005, p. 121).

Information letters that highlighted the purpose and aims of the study, test procedures, adverse effects of the test procedures, selection criteria and benefits and risks associated with the study (World Medical Association, Declaration of Helsinki, 2008), were given to the participants. In accordance with the Belmont Report (1979) and the Declaration of Helsinki (2008) every participant was notified of their entitlement to leave the study for any reason.

Beneficence and non-malfeasance.

Beneficence was achieved through the use of information provided in the informed consent that declared all risks and benefits that would arise from the tests involved as well as the study itself (Aita & Richer, 2005). Non-malfeasance was achieved by ensuring that participants were protected during testing procedures by the use of equipment such as gait belts, careful guarding during standing and ambulatory tests and explicit review of test protocols.

Confidentiality.

Confidentiality refers to the safe keeping of all data gathered during and after the study and restricting accessibility to the data by individuals outside the study (MRC, 2001).

A numerical coding system was used to safeguard the identity of participants from external personnel gaining access to participants' records. The data were stored separately from hospital folders and both soft and hard copies of participant data were kept secure in password protected safe. Participants will not be identifiable in this report or subsequent reports, as study and medical folders number will not be used to denote participants.

Justice

Participants were selected fairly and equally. The fair recruitment of participants was established by the non-discriminatory handing out of information letters, translated into Afrikaans and isiXhosa, to all patients attending the HIV clinics. The non-discriminatory process ensured every person had an equal opportunity to participate in the study.

CHAPTER 4

Results

This chapter will be guided by the aims of the study. Participant demography and dizziness symptomatology (Sub-aim1) will be presented first. Vestibular function will follow (Sub-aim2) and the findings of the PRD will be presented last (Sub-aim3).

Results

Sub-aim 1 results.

Sub-aim 1: To identify a sub-set of participants living with HIV who report subjective dizziness (symptomatic) and those who do not (asymptomatic), by self-report and case history. Results which pertain to sub-aim one are presented below.

Age and sex.

Participant ages ranged from 29 years of age to 52 years, with a mean age of 37.3 years. The sample consisted of 14 male and 18 female participants.

Language.

Of the thirty-two participants isiXhosa was the most spoken language (n=18) and English the second most spoken language (n=8). Afrikaans and other languages were equally spoken among the participants (n=3).

Antiretroviral use.

Antiretrovirals were used by 30 out of the 32 participants (93.75%) as can be seen in Figure 10 below.

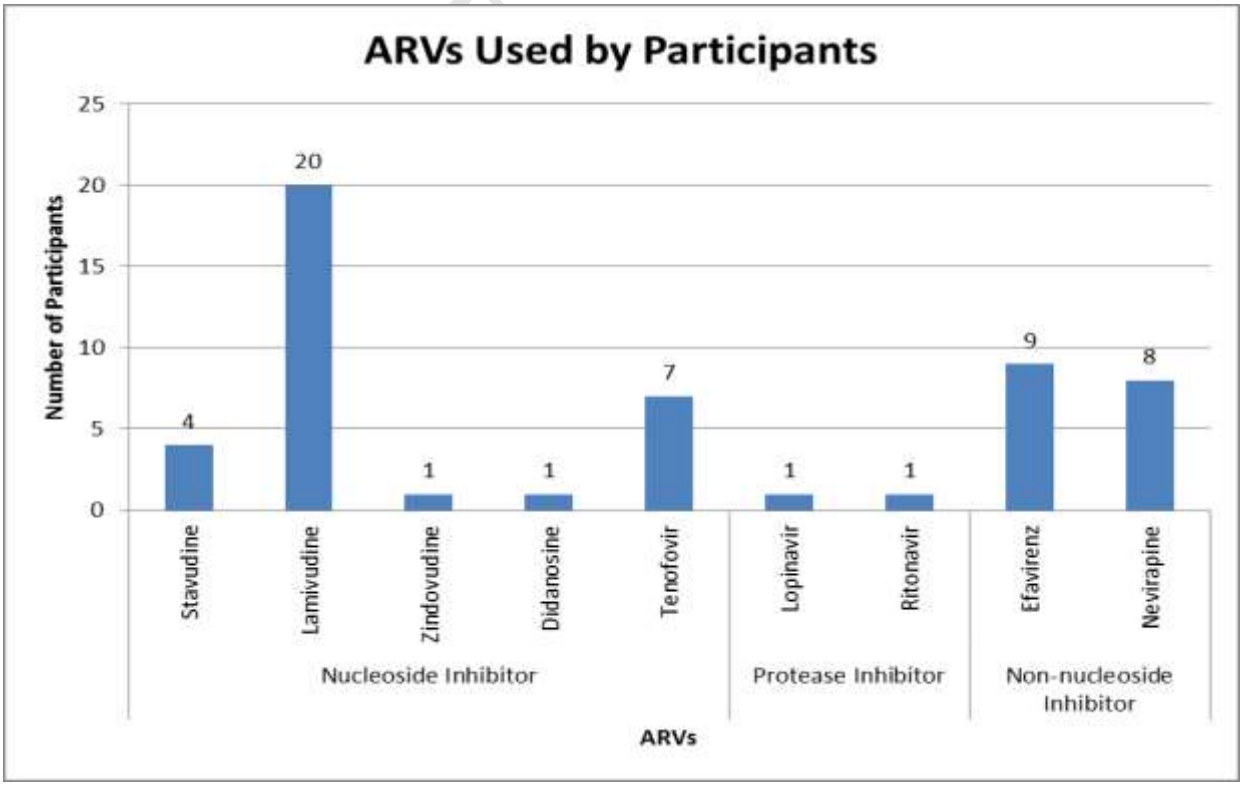

Figure 10: Use of ARVs by participants

Duration of treatment.

Twelve participants were found to be using ARVs for less than a year, 12 participants used ARVs between one and five years, three participants used ARVs between five and 10 years, two participants used ARVs for more than 10 years and three had unknown status of ARV use.

Dizzy participants.

Out of the 32 participants, 17 participants (53%) reported as not feeling dizzy and 15 (47%) reported experiencing dizziness; which will be described using the PRD algorithm. With 47% of the sample reporting as being dizzy, the prevalence of dizziness is high.

Types of dizziness categorised using the PRD.

Figure 11 shows the number of participants who reported experiencing dizziness or not, as well as each type of dizziness. The distribution of the dizzy participants is depicted using the PRD model in Figure 12. Three participants were classified under vertigo, two participants under disequilibrium, one under presyncope and nine participants were classified as experiencing non-specific dizziness; as their dizziness was attributed to situational events such as hypoglycaemia due to not eating and over exertion among other complaints which is discussed in the next chapter.

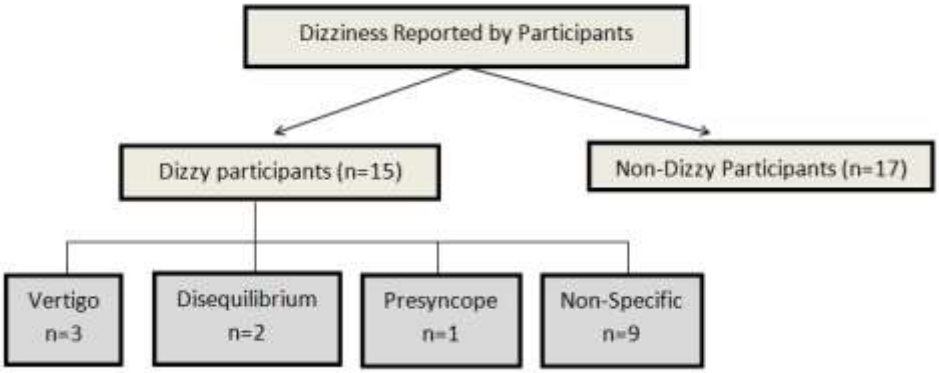

Figure 11: Report of dizziness types by participants

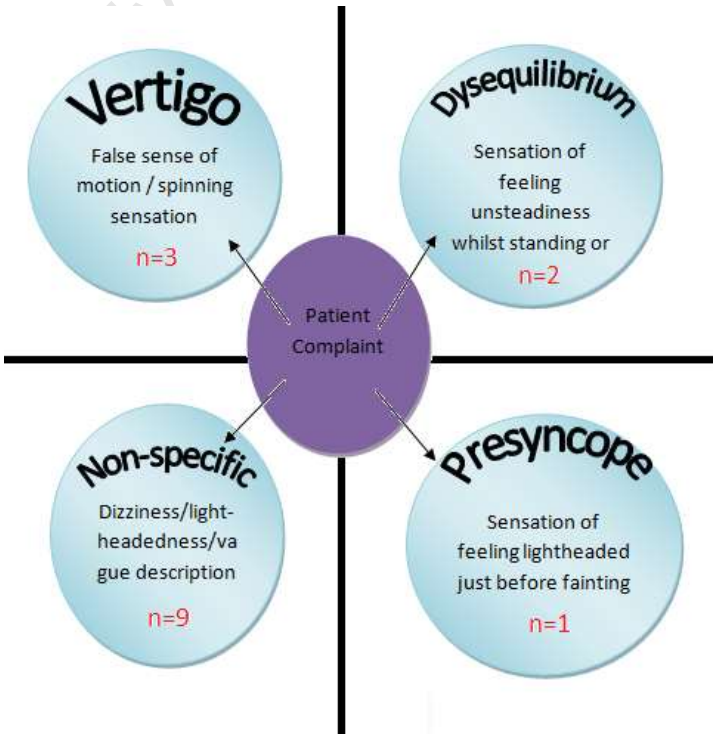

Figure 12: Dizziness categorised using PRD

Symptom profile of dizzy participants.

Table 3 below gives a symptom profile of all the 15 dizzy participants. As can be seen from Table 3 below, the symptoms reported by each participant in each category of dizziness varied.

Table 3 depicts the three participants in the vertigo category, who reported experiencing either subjective or objective vertigo, with varying associated symptoms suggesting different possible triggers of dizziness.

The dysequilibrium category depicts two participants, who reported as experiencing dysequilibrium as feeling off-balance. Both participants attributed the disequilibrium to hypoglycaemia but had different associated symptoms.

There was only one participant who was found to experience presyncope who could not be compared to other participants. Comparison to other participants could not be made as the participant was the only one who described a dizziness experience which met the definition of presyncope.

Nine participants were found to experience non-specific dizziness, and as with the other categories of dizziness, the variation in reported symptoms was large. No clear pattern of symptoms could be established which would suggest a particular aetiology for the dizziness. However, the most common attribution to the experience of non-specific dizziness was made to either medication (ARV) or hypoglycaemia and one participant attributing the dizziness to postural change. Two of the participants (D14 & D15) in the non-specific category were found to have abnormal VOR function, respectively.

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	Type of Dizziness	Vertigo			Dysequilibrium		Presyncope	Non-specific								
	Dizzy (D) Participant	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15
Symptom Information	ARV	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
	Report	S	O	O	OFF BAL	OFF BAL	BLK OUT									
	Before/After HIV	BF	AF	AF	BF	AF	BF	AF	AF	BF		AF	AF	AF	AF	AF
	Dsyphagia										✓					
	Dysarthria	✓														
	Dysmmetria															
	Diplopia									✓						
	Aggravating Factors	HYPG	HYPG	MEDS	HYPG	HYPG	PHYS ACT	MEDS	MEDS	POSTRL	MEDS		MEDS	HYPG	HYPG	MEDS
	Nausea	✓	✓	✓			✓	✓		✓						
	Vomiting	✓						✓	✓							
	Episodic		✓			✓	✓					✓			✓	✓
	Duration of Episodes	MIN	HRS		MIN	HRS	SEC	HRS	SEC	SEC		HRS			MIN	SEC
	No. Of Episodes/year	>10	5 – 10		>10	5 – 10	>10	<5	<5	<5		<5			<5	<5
	Headaches	✓	✓				✓	✓			✓		✓	✓	✓	
	Hearing Loss			✓							✓				✓	
	Tinnitus		✓	✓		✓		✓			✓	✓		✓		
	Ear Pain								✓							
	Aural Fullness			✓												
	Concomitant Illness					✓			✓			✓			✓	✓
	Bedside Evaluation	DNT	NORM	DNT	DNT	NORM	DNT	DNT	DNT	DNT	DNT	DNT	DNT	DNT	NORM	ABNORM
	Laboratory Evaluation	DNT	DNT	DNT	DNT	DNT	DNT	DNT	DNT	DNT	DNT	DNT	DNT	DNT	ABNORM	DNT

Table 3: Symptom & dizziness profile of dizzy participants (n=15)

LEGEND

S – subjective
O – objective
BF – before
AF – after
HYPG – hypoglycaemia
MEDS – medication (ARV)
SEC – seconds
MIN – minutes
HRS – hours
>10 – less than ten per year
5 – 10 – five to ten per year
>10 – more than ten per year
POSTRL – postural
DNT – did not test
OFF BAL – off balance
NORM – normal
ABNORM - abnormal
PHYS ACT - physical activity
✓ - yes
Blank boxes indicate no report of symptom

Non-Dizzy (ND) Participant		ND1	ND2	ND3	ND4	ND5	ND6	ND7	ND8	ND9	ND10	ND11	ND12	ND13	ND14	ND15	ND16	ND17
Symptom Information	ARV	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Dysarthria																	
	Dysmmetria																	
	Dysphagia																	
	Diplopia															✓		
	Nausea				✓	✓										✓		
	Vomiting																	
	Headaches				✓			✓				✓				✓		✓
	Hearing Loss	✓					✓											
	Laterality of Hearing Loss	U					B											
	HL Before/After HIV	AF																
	Fluctuating	✓																
	Tinnitus											✓				✓		✓
	Ear Pain																	
	Aural Fullness		✓															
	Concomitant Illness	✓						✓			✓	✓	✓			✓	✓	✓
	Illness	ASMA						DEPR			DEPR	DEPR	ARTH				MENG	HBP
	On Other Medication	✓						✓			✓	✓	✓				✓	✓
	Bedside Evaluation	DNT	DNT	DNT	DNT	DNT	DNT	DNT	DNT	DNT	DNT	DNT	DNT	DNT	DNT	DNT	ABNORM	ABNORM
	Laboratory Evaluation	DNT	DNT	DNT	DNT	DNT	DNT	DNT	DNT	DNT	DNT	DNT	DNT	DNT	DNT	DNT	DNT	DNT

Table 4: Symptom profile of non-dizzy participants (n=17)

LEGEND

ABNORM – abnormal	NORM – normal	DNT – did not test	ASMA – asthma	ARTH - arthritis
BF – before	✓ - yes	U – unilateral	DEPR - depression	HL – hearing loss
AF – after	B – bilateral	MENG – meningitis	HBP – high blood pressure	Blank boxes indicate no report of symptom

Table 4 above shows the symptom profile of all the 17 non-dizzy participants. All non-dizzy participants were on ARV treatment and only three underwent bedside evaluation, of which two had abnormal findings. It is interesting to see that although no dizziness experience was reported by participants ND16 and ND17 abnormal findings were found in the bedside evaluation. ND16 was found to have normal VOR function but failed the sharpened Romberg and m-CTSIB tests and was therefore considered to have abnormal results. The clinical results of ND16 and ND17 are presented further below.

What is noteworthy from both the dizzy and non-dizzy groups is that participant report did not coincide with bedside and laboratory evaluations in some instances, in terms of expected vestibular function. The participants who underwent bedside and/or laboratory evaluations all had differing results when compared to the dizziness reported. Almost a third (26.7%) of the dizzy participants were found to have normal vestibular function through bedside assessment and 11.6% for the non-dizzy participants were found to have abnormal vestibular function through bedside assessment.

Self-assessment scales.

Table 5 below shows the scores of the two self-assessment scales (VSS and DHI) with median and standard deviation values. The results of the two self-assessment scales are described below.

Vertigo Symptom Scale							
Sub Scales	**No. Participants**	**Range Of Scores**		**Maximum Score Attainable**	**Average Participants' Score**	**Median Participants' Score**	**Standard Deviation**
		Min	**Max**				
Anxiety	32	0	13	60	4.34	1	3.22
Vertigo		0	32	76	2.22	1.5	6.66
Total		0	45	136	6.56	2	9.5
Dizziness Handicap Inventory							
Sub Scales	**No. Participants**	**Range Of Scores**		**Maximum Score Attainable**	**Average Participants' Score**	**Median Participants' Score**	**Standard Deviation**
		Min	**Max**				
Physical	32	0	16	28	1.63	0	4.23
Emotional		0	18	36	2.44	0	5.37
Functional		0	20	36	2.38	0	4.99
Total		0	44	100	6.44	0	13.5

Table 5: Findings of self-assessment scales (n=32)

Vertigo Symptoms Scale.

The VSS identified the three participants who experienced vertigo, separate from those in the case series below, as their scores were the highest in the two sub-scales and were the highest in the total score. Based on the total scores of the participants for the VSS, the majority of participants did not perceive any loss of control or fear due to vertigo, somatic anxiety, somatization and hyperventilation. Low scores were seen across all participants in both sub-scales (Table 5).

Dizziness Handicap Inventory.

The DHI identified five participants as experiencing a mild or moderate handicap. Table 5 shows that the majority of participants did not perceive their dizziness a cause of handicap or were at a risk of falling.

Although the DHI is primarily aimed at assessing the impact of dizziness on the quality of life of the patient, it also provides results which can be related to functional balance impairment tests such as the DGI. Even though a statistical relationship was not explored between the DHI and DGI in this study, previous research has shown that the DHI and DGI correlate well ($r=-0.69$ when $p=<0.01$) which suggests that scores on the two scales can correlate (Vereeck, Truijen, Wuyts & Van de Heyning, 2007); correlations were not explored in this study's sample as the focus of the study was on dizziness and not functional balance impairment.

DHI and VSS scores were compared via a Mann-Whitney test between the two groups of participants (dizzy and non-dizzy) and p-values of the test were found to be insignificant ($p=0.1438$ and $p=0.1357$ respectively).

Summary of sub-aim 1 results.

The aim of sub-aim 1 was to identify a sub-set of participants living with HIV who report subjective dizziness and those who do not, by self-report and case history.

The results of sub-aim 1 showed the sample consisted of participants with a mean age of 37.3 years and the most common language spoken being isiXhosa. Ninety-three point seven per cent (93.7%) of the sample was found to be on ARV treatment which the majority of, were on ARVs from zero to five years. A high prevalence (47%) of dizziness was found in the sample, with non-specific dizziness being the most prevalent (60%). Classification of the dizziness found in the sample was achieved using the PRD (which is detailed in Sub aim 3's results later in this chapter). The VSS found low scores across all participants in both sub-scales, but was able to identify the participants who reported vertigo. The DHI found that the majority of participants did not perceive their dizziness a cause of handicap or had gait and dynamic balance problems, but also identified five participants as experiencing a mild or moderate handicap.

Sum-aim 1 was able to identify the sub-sets of symptomatic and asymptomatic participants however the small number of participants affected the statistical analysis and significance of the study.

Sub-aim 2 results.

Sub-aim 2: To evaluate and describe the relationship(s) between the vestibular function within the asymptomatic and symptomatic dizziness groups and the symptomatic dizziness gropus and the symptomatic and clinical profile.

CD4 count and report of dizziness.

The relationship between the CD4 count of participants and reported dizziness was explored with a Kruskal-Wallis test. No significant difference was found between the participants reporting being dizzy or not and their CD4 counts (p=0.3938).

CD4 count and symptom presence.

The relationship between the CD4 count of participants and the presence of symptoms was evaluated by the Spearman correlations. **Error! Reference source not found.** below depicts the relationships between CD4 count and symptom presence for the dizzy and non-dizzy participants, through r-values and p-values. With regard to the absence of some values for some symptoms is due to the absence of symptom report and also due to absence of data. No correlation was seen between the CD4 count of participants and the report of the different symptoms in each of the dizziness categories.

Dizzy Participants (n=15)			**Symptoms**	**Non-Dizzy Participants (n=17)**		
r-value	**p-vlaue**				**r-value**	**p-vlaue**
-0.131	0.685	CD4 Count	Dysphagia	CD4 Count		
.02184	0.495		Dysarthria			
0.2591	0.416		Diplopia			
0.0512	0.75		Nausea		-0.1543	0.615
-0.2591	0.416		Vomiting			
0.0	1.0		Headaches		0.2928	0.332
			Hearing Loss		-0.488	0.091
0.0512	0.874		Tinnitus		-0.1709	0.577
			Aural Fullness		0.3858	0.193

Table 6: CD4 count and symptom presence correlations

The relationship between the sum of all symptoms reported and CD4 count of all the participants (n=32) was explored through Spearman correlations and is displayed in Table 7 below. No significant correlations were seem between the CD4 count and individual symptoms or the sum of all symptoms (p=0.518).

All participants (n=32)			
CD4 Count	**Symptom**	**r-value**	**p-value**
	Dysphagia	-0.113	0.59
	Dysarthria	-0.1841	0.379
	Diplopia	0.1023	0.627
	Nausea	0.1595	0.446
	Vomiting	0.2659	0.199
	Headaches	0.0636	0.763
	Hearing Loss	-0.1964	0.347
	Tinnitus	-0.104	0.621
	Aural Fullness	0.3115	0.13
	Sum of All Symptoms	**-0.1355**	**0.518**

Table 7: Correlation of sum of symptom presence and CD4 count

ARV usage and dizziness experience.

The relationship between participants' use of ARVs and reported dizziness (presence or absence) was evaluated using Pearson Chi and Fisher's exact tests. No significant relationship was identified between ARV use and the report of any type of dizziness (p=0.345). Table 8 below shows the statistical evaluation between ARV use and dizziness experience.

	Dizziness		
ARV Use	No	Yes	Total
Yes	25	5	30
Row %	83.33	16.67	100
Col %	96.15	83.33	93.75
No	1	1	2
Row %	50	50	100
Col %	3.85	16.67	6.25
Total	26	6	32
Row %	81.25	18.75	100
Col %	100	100	100
Pearson's Chi: 1.3675		Fisher's exact: p=0.345	

Table 8: ARV use and dizziness experience statistical calculation

Clinical and Laboratory assessment findings.

Table 9, below summarises the six participants who underwent clinical and laboratory assessments; only positive findings are displayed. Results summarised in Table 9 will be discussed in a case series format. Only six participants underwent bedside and/or laboratory assessment as a large proportion of participants declined to participate in the study following the case history taking. The symptoms reported by the participants are displayed in Table 3 and Table 4 shown in Sub-aim1's results.

		Participants who underwent clinical/laboratory assessments					
		D2	**D5**	**D14**	**D15**	**ND16**	**ND17**
Age (years)		32	31	32	47	21	31
CD4 Count		179	396	350	280	256	102
Dizzy		Yes	Yes	No	No	No	No
Type of Dizziness		Vertigo	Dysequilibrium	Non-specific	Non-specific	None	None
VSS (Max 136)		32	15	45	19	9	2
DHI (max100)		0	44	40	16	4	20
Clinical Assessment	**Spontaneous Nystagmus**	N	N	N	N	N	N
	Gaze	N	N	N	Unilateral	N	Unilateral
	Saccades	N	N	N	Hypometric	N	Hypometric
	Smooth Pursuit	N	N	N	Abnormal	N	Abnormal
	Head Thrust	N	N	N	Corrective saccade	N	Corrective saccade
	Romberg	N	N	N	N	S EC&EO	N
	m-CTSIB	N	N	N	N	F EC&EO	N
Audiometry	**Hearing Loss**	DNT	DNT	Unilateral, mild, conductive	DNT	DNT	DNT
	Immittance	DNT	DNT	Right: CNE, Left: Type A, Reflexes CNE	DNT	DNT	DNT
VNG Assessment	**Spontaneous Nystagmus**	DNT	DNT	N	DNT	DNT	DNT
	Gaze	DNT	DNT	DNT	DNT	DNT	DNT
	Smooth Pursuit	DNT	DNT	Abnormal	DNT	DNT	DNT
	Head Shake	DNT	DNT	Left beating	DNT	DNT	DNT
	Hyperventilation.	DNT	DNT	DNT	DNT	DNT	DNT
	Caloric	DNT	DNT	CNE	DNT	DNT	DNT

Table 9: Participants who underwent clinical and/or laboratory assessments; positive findings displayed (n=6)

Legend

F = Foam
DNT = Did Not Test
CNE = Could Not Evaluate
S = Sharpened
EC = Eyes Closed
EO = Eyes Open

Participant D2.

Vertigo was reported by Participant D2, whose clinical assessment yielded normal results and did not undergo VNG assessment. Participant D2's CD4 count was relatively low (Stage III infection), had a low VSS score and nil DHI score.

Participant D5.

Dysequilibrium was reported by Participant D5, whose clinical assessment yielded normal results and did not undergo VNG assessment. Participant D5 was in stage II HIV infection based on the CD4 count and had a low VSS score and the DHI score indicated a moderate perceived handicap.

Participant D14.

Non-specific dizziness was reported by Participant D14, whose clinical assessment yielded normal results. Pure tone audiometry demonstrated a mild, conductive hearing loss in the right ear and normal hearing in the left ear. VNG assessment findings included no spontaneous or gaze nystagmus, abnormal smooth pursuit, left beating nystagmus post head shake and no nystagmus was observed post hyperventilation. Caloric irrigation was not conducted due to a possible cholesteatoma. Participant D14 was referred to ENT for an assessment and follow-up could not be done, as the participant could not be contacted telephonically. Upon follow up through hospital records, Participant D14 did not visit the ENT department for investigation of the possible cholesteatoma.

Participant D15.

Non-specific dizziness was reported by Participant D15, whose clinical assessment yielded, true gaze nystagmus when looking to the right, hypometric saccades in one direction (right), abnormal smooth pursuit and corrective saccade on head thrust. Bedside assessment results suggest definite vestibular lesion with a central involvement in the absence of true vertigo. VNG assessment was not conducted.

Participant ND16.

No dizziness was reported by Participant ND16 who had normal VOR function but failed the sharpened Romberg as well as the modified CTSIB test (in the eye-closed and eyes-open conditions); 18 seconds and 23 seconds for the two conditions respectively. VNG assessment was not conducted.

Participant ND17.

No dizziness was reported by Participant ND17, whose clinical assessment yielded true gaze nystagmus, hypometric saccades in one direction (left), abnormal smooth pursuit and corrective saccades on head thrust. Bedside assessment results suggest definite vestibular lesion with central involvement in the absence of any dizziness. VNG assessment was not conducted.

Clinical and laboratory assessments and patient report.

No statistically significant findings could be established due to the very small number of participants who were assessed clinically and through VNG. However, interesting clinical findings were found between the report of dizziness and the lack of clinical results; which will be discussed in the next chapter.

Dynamic Gait Index and patient report.

Patient report in terms of dizziness (dizzy, not dizzy) was correlated with DGI scores via a T-test. A p-value of p= 0.178 was observed indicating no significant correlation between patient report and DGI scores for all participants (n=6) who were evaluated by the bedside assessment; as only six participants underwent the bedside assessment where the DGI was administered.

Participant ND16, who failed the sharpened Romberg test, had a DGI score of 23 which indicates minimal or no risk of falling. The fact that participant ND16 failed the sharpened Romberg test and did not score below 21 on the DGI is interesting as it would be expected that difficulty in the Romberg test would result in a score below 21 in the DGI; which was not found in this instance.

Summary of sub-aim 2 results.

The aim of sub-aim 2 was to relate vestibular function within the symptomatic and asymptomatic dizziness groups and to explore relationships between the presence of symptoms and clinical findings.

The results of sub-aim 2 showed that although there was no significant statistical relationship between CD4 count and duration of use, an increase in CD4 counts was seen in the first year of treatment which was a medical improvement but not a relationship between dizziness report, self-assessment scales and bedside and/or laboratory assessments. No relationship was established between ARV and dizziness experience. Clinical and laboratory findings showed some interesting findings, but failed to establish any statistical correlation between clinical, laboratory and patient report of dizziness. There was no correlation found between the DGI and patient report.

Sum-aim 2 was not answered as the small sample did not yield sufficient data from which relationships between presence of symptoms and clinical findings could be established.

Sub-aim 3 results.

Sub-aim 3: To develop a patient-centered four type model to classify dizzy participants based on symptomatology of common balance disorders.

Development of a patient-centered model

A model based on literature of common dizziness symptomatology was successfully developed and named Patient-Report-Diagnosis (PRD). The mechanics of the PRD model are explained and detailed in Chapter 2.

Classification of dizzy participants

The PRD was able to classify the dizzy participants into the four categories of the algorithm. Figure 13 below depicts the distribution of the dizzy participants within the PRD algorithm. Dizzy participants were slotted into the four different dizziness types by qualitatively comparing the reported description to the definitions of the four types of dizziness; as the PRD is based on patient report.

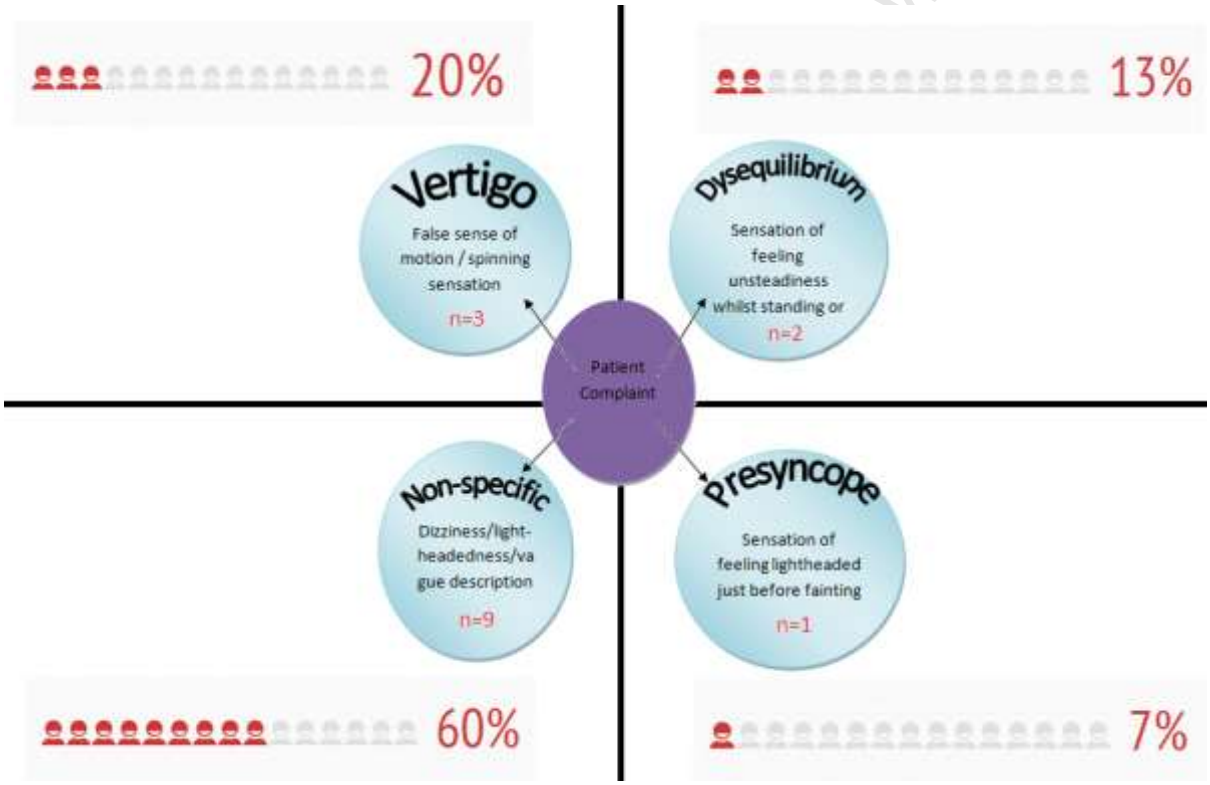

Figure 13: Distribution of dizzy participants in PRD

Identifying possible aetiologies

No possible aetiologies were found in the dizzy participants as there were no links between the symptoms reported. The PRD was developed on common dizziness symptoms, however the combination of symptoms which the dizzy participants reported did not match those in the PRD and therefore no possible aetiologies (diagnoses) of the types of dizziness could be established.

Situational and/or triggers of dizziness rather than aetiological links were established between the dizziness experience and symptoms reported by the dizzy participants. Hypoglycaemia, side-effects of ARV medication, physical activity and postural change were found to be the causes of the different types of dizziness reported.

Identifying possible triggers of dizziness

Possible triggers were identified in the dizzy participants, which were drawn from the situational relationships established. The Figure 14 below depicts the number of dizzy participants who had possible peripheral, central, vascular and psychological/situational triggers of dizziness, based on the PRD algorithm. Although medical related illnesses could not be linked to the dizziness reported by the participants, it is clear that there was a high prevalence of dizziness nonetheless.

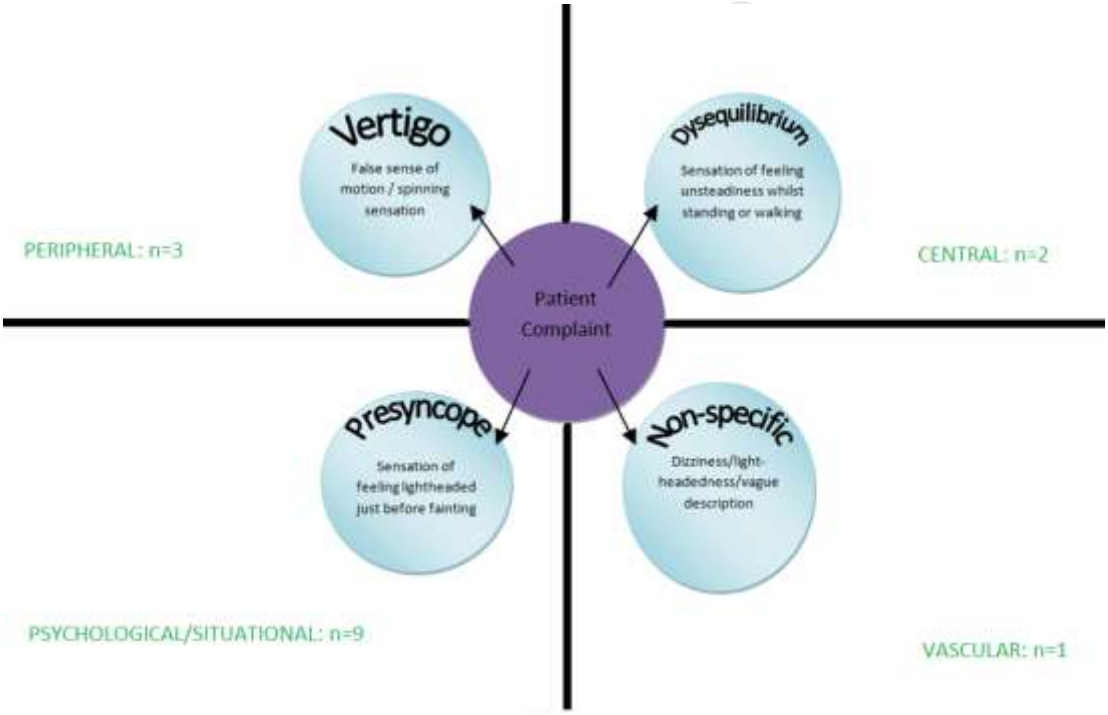

Figure 14: Possible triggers in dizzy participants identified by PRD model

Figure 15 below which was drawn from the PRD model shows the prevalence of dizziness triggers in the dizzy participants.

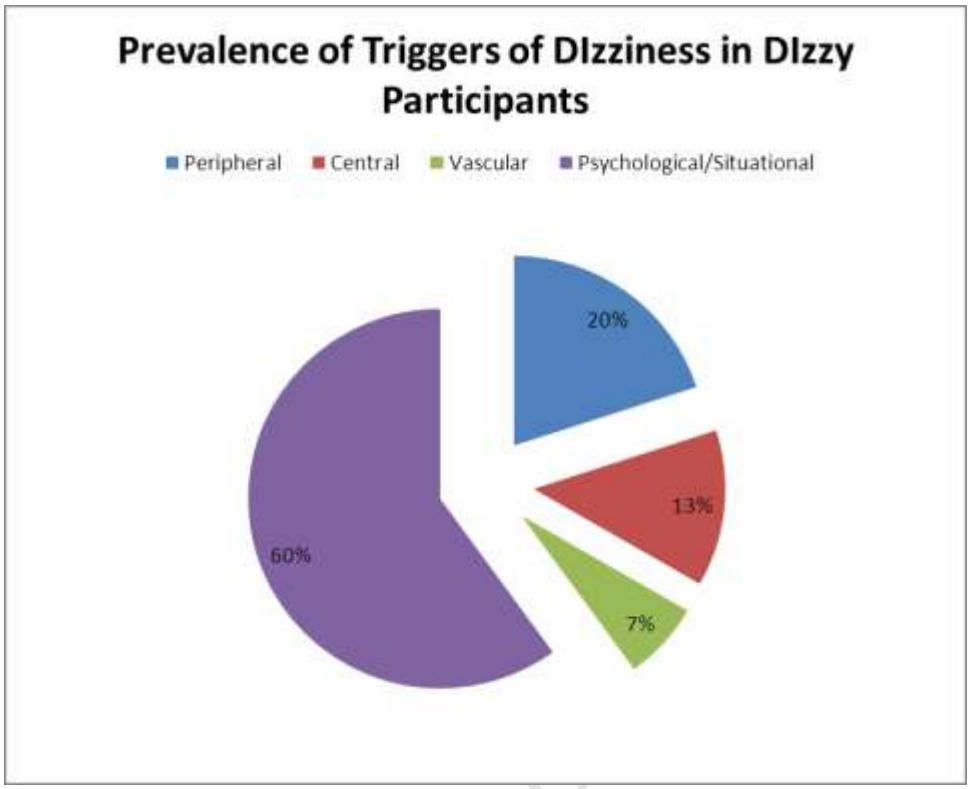

Figure 15: Prevalence of tirggers in dizzy participants

Drawing from the outcomes of the bedside evaluation and the dizziness reports of the participants, it was noted that although the PRD categorised the participants into dizziness categories, some of the results from the bedside evaluation did not coincide with the PRD diagnoses. For example, in the non-specific category two participants (D14 and D15) underwent bedside evaluation and participant D14 underwent laboratory evaluation. Participant D14 is interesting as the bedside results indicated normal vestibular function whilst the laboratory evaluation indicated abnormal function. Although the dizziness described by D14 fitted into the non-specific category, the laboratory evaluation was the only assessment method which identified vestibular abnormalities; which could suggest that the participant had a compensated vestibular lesion. Similarly, participant D2 who reported vertigo was classified as possibly having a peripheral trigger of dizziness but on bedside evaluation, normal vestibular function was found.

Model's utility

The PRD model was found to be partially useable. The partial utility of the PRD model was due to the fact that although it was able to classify dizzy participants into one of the four types of dizziness categories, based on the dizziness experiences reported, it was unable to establish possible aetiologies. The inability of the PRD to link symptomatology to a specific aetiology within each category shows its weakness in the HIV population. However, although possible aetiologies were not identified, possible triggers of dizziness were identified in the dizzy participants. Although the non-specific category had the largest number of dizzy participants, the lack of participants in the other categories such as vertigo adversely affected the usability of the PRD. With a larger sample of dizzy participants in the other dizziness categories, the PRD may have been found to be more useful; as most of the triggers of dizziness found were general medical problems rather than specific vestibular lesions.

Summary of sub-aim 3 results.

Using literature and clinical experience, a patient-centered model was developed, namely the PRD model. The PRD was able to allow categorisation of dizzy participants into the four groups of dizziness but due to the high number of participants in the non-specific category, the PRD did not allow for very fine definition of the dizziness experiences; which would appear to be linked to general medical issues. Therefore, the need for expansion of the non-specific category to include other triggers other than psychological factors will be discussed in the next chapter.

CHAPTER 5

Discussion

This chapter provides discussion on the results of the study. The following findings will be discussed:

- Results found related to Sub-aim 1
- Results found related to Sub-aim 2
- Results found related to Sub-aim 3
- Otologic assessment of people living with HIV
- Limitations of the study
- Future implications

Sum Aim 1: To Identify a Sub-Set of Participants Living with HIV Who Report Subjective Dizziness (Symptomatic) and Those Who Do Not (Asymptomatic), by Self-Report and Case History

Dizzy participants and types of dizziness.

All four types of dizziness, outlined in Chapter 2, were found in this study; vertigo (n=3, 9%), dysequilibrium (n=2, 6%), light-headedness (n=1, 3%) and non-specific dizziness (n=9, 28%). This study found a large percentage (47%) of its sample, of who experienced one of the four types of dizziness. Nearly 50% (n=15) of the participants of this study were found to be dizzy which correlates with the reports of dizziness being common in the HIV population however, only (n=3) of the participants were vertiginous. The difference in this study was that although nearly half of the sample was dizzy, the report of vertigo was very small, which is in contrast to previous studies where vertigo was the largest type of dizziness documented. Some participants (n=9, 28%) reported being dizzy, but did not classically fit into one of the four types of dizziness outlined in the literature review, and were therefore categorised under the non-specific dizziness type. Situational events such as hypoglycaemia due to not eating, over-exertion and non-routine taking of medication, among other factors were considered to be the cause of the anomalous dizziness reported.

Considering that the category of non-specific dizziness is often regarded as dizziness of psychogenic origin; the non-specific nature of the dizziness reported by the participants requires the category to expand and to accommodate other types of non-specific dizziness other than psychogenic dizziness. Non-specific dizziness was the most common variant of dizziness that this study found and would suggest that clinicians working with HIV populations could increase their recognition of such reports of dizziness.

Recent literature (Newman-Toker, Cannon, Stofferahn, Rothman & Nsieh, 2007; Cheung et al., 2010; Tarnutzer, Berkowitz, Robinson, Hsieh & Newman-Toker, 2011; Newman-Toker, 2012) puts forward a notion of moving from using symptoms to diagnose dizziness towards focusing on timing and triggers of dizziness. The reason for the shift towards dizziness timing and triggers is that

research has shown that patient report of dizziness is highly variable (Cheung et al., 2010) and using the symptoms approach to diagnose dizziness is unreliable (Newman-Toker, 2012). In addition, small studies have shown that no association exists between dizziness type and final clinical diagnosis (Cheung et al., 2010; Newman-Toker, 2012), which this study found in its sample. Furthermore, by using dizziness timing and triggers of dizziness, the accuracy of classification of dizziness is increased as patients have been found to consistently report these aspects compared to general dizziness experience (Newman-Toker, 2012).

With recent literature and the findings of the current study, the need to broaden the non-specific category to accommodate situational and triggers of dizziness is justified, in order to improve classification and diagnosis of dizziness. Consequently, the PRD model would have to be amended to focus on triggers and dizziness timing instead of symptoms so as to improve classification and diagnosis of dizziness.

Self-assessment scales.

Based on the results of their self-assessment scales, the vertigo and handicap experienced by the small number of participants who reported it, was not severe.

Vertigo symptom scale (VSS).

Only three participants were identified by the VSS to experience vertigo. The ability of the VSS to distinguish between vertiginous and non-vertiginous participants was shown in the study, suggesting it may be a helpful tool in the HIV population, similarly as it has been in researched non-HIV populations.

Dizziness handicap inventory (DHI).

The DHI was able to identify five participants, separate from those in the case series above, who perceived a handicap as a result of their dizziness.

Other benefits of using the DHI as an additional tool in the assessment process includes its ability to provide a baseline measure to assess treatment outcomes (Whitney, Marchetti & Morris, 2005), assists the clinician in asking about handicap perception (Treleaven, 2006; Toh, 2008) and focuses the patient's thoughts on areas they would like to improve; which aids in the formulation of therapeutic goals (Treleaven, 2006).

Benefits such as those mentioned above further warrant the use of self-assessment scales as tools in the routine assessment of dizzy patients, as state run HIV and ENT clinics are usually very busy and as clinicians find it difficult to probe areas of handicap. Clinicians working in busy clinics usually do not use outcome measures (Hatfield & Ogles, 2007) which highlights the potential use of self-assessment scales to establish baseline and treatment responses. Furthermore, self-assessment scales can assist with the assessment and discrimination of physical, emotional and psychological symptoms. However, the appropriate choice of self-assessments and questions to address particular diseases or disorders is crucial.

Previous studies such as the one by Chandrasekhar et al. (2000) used an otologic questionnaire which was designed by the researchers, and the reliability and validity of their research tool was not reported in their study. Utilising non-standard and validated questionnaires

could have impacted the assessment findings of that study and as a result the report of symptoms. The implementation of extensively researched self-assessment scales was a benefit to this study. The scales brought an additional dimension to the assessment as they assisted with symptom definition and probed for levels of anxiety and perceived handicap (Whitney et al., 2004; Toh, 2008). The concepts of anxiety and handicap, embedded and explored in the self-assessment scales, would allow for them to be addressed in management (Whitney et al., 2004; Tamber et al., 2009).

With known correlation between the DHI and DGI (Vereeck, Truijen, Wuyts & Van de Deyning, 2007), the possible reason for which low self-perceived levels of handicap were found in conjunction with good results on the DGI, could be that the participants were not at risk for falling and had good measures of dynamic balance.

Sub-aim 2: To Relate Vestibular Function Within The Symptomatic and Asymptomatic Dizziness Groups and to Explore Relationships Between the Presence of Symptoms and Clinical Findings.

CD4 count and duration of treatment.

Categorising periods of use in years, this study found a marked difference in the CD4 count of participants who were using ARVs. The mechanism of ARVs in essence, is that they increase CD4 cells, so as to increase immunity (Belavic, 2010). With increased immunity, the probability of vestibular damage by HIV is reduced as the virus is suppressed (WHO, 2003). These data relate to overall medical conditions already described as otologic manifestations of HIV well documented in literature related to VIII nerve conditions. Therefore, it would be expected that with increased or continued use of ARVs the CD4 count of HIV patient would increase and render patients less to opportunistic infections.

There was a significant increase from the first year of use to five years of use ($p=0.0033$). With a significant increase in CD4 counts from one to five years of use, the HIV patient reduces their chances of developing vestibular dysfunction, based on the evidence that HIV affects the vestibular system anatomically (Chandrasekhar et al., 1992; Pappas et al., 1995) and physiologically (Chandrasekhar et al., 2000; Teggi et al., 2008). The increase in CD4 counts and its resultant reduced impact of the HIV on the vestibular system may be a reason why almost half of the sample was found not to be dizzy.

CD4 count and report of dizziness.

No statistical relationship ($p=0.3938$) was found between the CD4 counts and the report of dizziness in the sample (either reporting being dizzy or not). Studies by Teggi and colleagues (2006; 2008) found that with increasing stage of infection (lower CD4 count) was related to increased vestibular damage but did not explore how stages of infection presented as symptoms in PLHIV. The lack of a relationship between CD4 count and reports of dizziness in this study could be related to the small sample size as well as the unusual presentation of dizziness symptoms in the sample; when compared to dizziness symptoms reported in populations living without HIV.

CD4 count and presence of dizziness and associated symptoms.

In this study it was found that there was no relationship between the CD4 count and the report of dizziness (p=0.3938) nor the presence of associated symptoms (p=0.518). HIV has been shown to cause damage to the vestibular system anatomically and in terms of physiological function. As CD4 counts provide a measure of the strength of immunity (WHO, 2003), it could be expected that people with low CD4 counts, are more likely to have vestibular related dizziness.

Although clinical reasoning would suggest that dizziness would be more prevalent in patients with lower CD4 counts, the consequence of opportunistic infections must be taken into account as dizziness may be a common complaint. The lack of a statistically significant relationship between CD4 count and dizziness may be attributed to the influence of ARV use; which increases CD4 count and thereby increasing immunity. The lack of statistically significant correlation between the CD4 count and symptom presence most likely was affected by the small sample as well as the wide range of symptoms which a person living with HIV can possibly experience.

ARV use and dizziness experience.

No significant relationship was found between ARV use and dizziness experience (p=0.345) in the sample of this study. Side-effects of ARVs may be a cause of dizziness experienced by patients, as several of ARVs have dizziness as a side-effect (Hawkins, 2006; DiBonaventura, Gupta, Cho & Mrus, 2012). The lack of a significant relationship between the two variables may have been affected by the small sample size and the individual participant compatibility to the ARVs.

Otologic Assessment of People Living With HIV

Otologic assessment was found to be multifaceted compared to previous studies which focused on instrumentation such as ENG, audiometry, VNG and calorics (Hausler et al., 1991; Chandrasekhar et al., 2000; Khoza & Ross, 2002; Teggi et al., 2006; 2008). Although weak statistics and a limited sample hindered this study, the proposed three tiered (case history & self-assessments, bedside and laboratory evaluations) assessment system can be considered to be superior to relying on one tier of assessment, which was the focus of previous studies. Since the 1990s several studies have examined dizziness in the HIV positive adult population (Hausler et al., 1991; Chandrasekhar et al., 2000; Teggi et al., 2006; 2008), with similar methodologies, one tier of assessment, heavily focused on specialised investigations and similar short-comings (Heinze et al., 2011). However, these previous studies provided a base from which future studies could be carried out, such as this one.

The assessment of vestibular function in HIV positive adults is not simple as there are several factors to consider, from physiological function of the auditory and vestibular systems to the patient's perception of dizziness. This study drew from previous studies to formulate a comprehensive three tiered examination protocol which addressed all factors that could contribute to a dizziness experience.

With a superior examination protocol holistic management can be achieved which is the direction the medical fraternity is moving towards (Lee & Elder, 2013). With regard to the South African context where resources are limited, simple but information rich strategies such as the first tier (case history)of this study's assessment protocol may be a very useful tool in the assessment of

dizziness as well as to monitor ARV related ototoxicity (Khoza-Shangase, 2010; Assuiti, Lanzoni, dos Santos, Erdman & Meirelles, 2013).

Case history.

Case history was found to be beneficial in this study as it provided immediate and relevant information from the participants and their records, which assisted in the accurate identification and classification of dizziness. The aspect of case history, which was evidently lacking from all previous studies, was the entry point from which this study began its assessment of the HIV positive adult. Research is needed on specific entities such as dizziness, which may be an associated complaint to an illness, which may be a highlighting symptom with regard to a particular disease or disorder (Donner-Banzhoff et al., 2001; Sherman et al., 2007).

The case history provides information which is essential (Chawla & Olshaker, 2006) when attempting to classify dizziness in the HIV positive adult, however, greater attention needs to be made towards identifying triggers and not symptoms. By incorporating different aspects of the participants' history, such as ARV information, concomitant illnesses, medications used, previous surgeries and the perception of dizziness experienced via self-assessment scales, participants' were viewed globally, unlike in previous studies (Hausler et al., 1991; Teggi et al., 2006; 2008). Other factors such as medications used and current and previous illnesses, were taken into consideration as they may have contributed to the dizziness experienced by the participant (Turnidge, 2003; Ryback & Whitworth, 2005). Without the case history inaccurate conclusions would be made with regard to the type and nature of dizziness described by the participant.

The importance of the case history is illuminated in the results of this study, which has illustrated that even in the presence of normal clinical findings; dysfunction may be present in the person living with HIV. Due to the inability of tests to evaluate symptoms, the need to rely on symptom report is highlighted. However, the possibility of finding signs of vestibular dysfunction, which for a variety of reasons (gradual nature of onset, central lesions causing low grade nystagmus, adaptation) may not communicate themselves as symptoms, does exist. Therefore, the ideal protocol would be to conduct a case history and a clinical examination. The use of laboratory results is still a debate within the audiological arena as global standardised norms have not been established, to determine severity or presence of dysfunction (Wuyts, Furman, Vanspauwen & Van de Heyning, 2007). Another challenge is the selection of specific tests to assess patients with a particular problem versus conducting a full battery of tests (Gans & Yelling, 2007), with regard to the clinical examination.

Clinical assessment.

Although a broad vestibular assessment battery was adopted by this study, which allowed for correlations to be made between tests, such correlations were unable to be calculated due to the small sample size. However, despite the lack of statistic correlations, a few interesting results were found which included the discovery of Participant B's cholesteatoma and the nature of vestibular dysfunction found in the clinical assessments. Participant B's cholesteatoma was a notable finding as although clinical assessment findings did not yield any results, the VNG assessment identified dysfunction which would have otherwise been missed. The other interesting outcome was the mixed nature of results obtained in the clinical assessments. Participants D and F were found to have signs of both peripheral and central dysfunction which was indicated by the abnormal gaze and smooth

pursuit results (oculo-motor/central signs) (Kuo et al., 2008; Tusa, 2010), in conjunction with the positive head thrust test results (peripheral signs) (Kuo et al., 2008, Tusa, 2010). The mixed nature of pathologies found in this study are similar to Teggi and colleagues (2006) findings which showed with increasing HIV infection, the presence of mixed pathologies also increased.

A broad battery of tests was selected that assessed different aspects of the balance and vestibular systems, which would ensure that the participants were assessed comprehensively. The assessment of the vestibular system comprises of different tests which cannot be used individually as each test provides different information which is substantiated by other tests (McCaslin et al., 2008). Previous studies (Teggi et al., 2006; 2008) fell short in their assessment protocols as only particular sets of tests were chosen, which limited the view of the function of the vestibular system. For example, the study by Teggi and colleagues (2008) relied solely on findings from VNG and not the clinical examination. In contrast, the current study implemented a battery which assessed the dizzy participants' balance related systems; vestibular-ocular and vestibular-spinal reflexes, auditory function, eye and visual functions, cerebellar function and cranial nerve integrity, while respecting professional boundaries and scope of practice.

Laboratory assessment.

Only one participant underwent laboratory assessment which was insufficient to establish correlations between laboratory findings, case history and the bedside assessment. The use of a laboratory assessment, in the form of VNG, was planned to be conducted in conjunction with a clinical assessment, so as to strengthen the clinical findings. The laboratory assessment included a battery which was similar to the clinical assessment, (viz., spontaneous and gaze nystagmus, tests of oculo-motor function and positioning tests, and calorics), except the analysis of findings which was computerised, thus allowing quantitative analysis (Shepard & Schubert, 2008). The limitations of VNG are recognised, as while VNG adds value to the assessment, it is not comprehensive (Gananca et al., 2010). VNG tests at low frequency (Gans & Yellin, 2007) which only enables the clinician to describe the state of the vestibular system and not its functionality; which can only be reported by the patient.

Although only one participant underwent a laboratory assessment in this study, tests such as VNG have the potential to add value to an overall evaluation of a patient's status. The use of computerised assessment serves as a tool through which quantitative values can be obtained in the diagnosis of vestibular dysfunction (Shepard & Schubert, 2008). For example, a test in the clinical assessment battery may indicate dysfunction of a particular aspect of the vestibular system, whereas the VNG would provide the degree of dysfunction. In some cases VNG is able to provide objective evidence of dysfunction, which serves as a baseline for on-going monitoring (Shepard & Schubert, 2008) and in some cases gives helpful insights into the correct approach for therapy (Gananca et al., 2010). However, it must be noted that VNG is limited as it cannot differentiate between the presence and absence of pathologies (Gananca et al., 2010). VNG provides quantitative information which needs to be incorporate case history and clinical test results, to reach a diagnosis (Gans & Yellin, 2007). The unfortunate lack of VNG results in this study highlights the need for exploration of the role of VNG and its usefulness in greater depth, in HIV/AIDS populations in future studies.

Relating case history information to clinical and laboratory findings.

The capacity of this study to explore relationships between participant report and clinical and laboratory findings is something that previous studies were incapable of doing due to their constricted methodological constructs. However, despite being restricted by a small sample size, this study has proposed a functional protocol with which patient experience and clinical findings may be linked. Importantly, the appreciation of aspects of the individual's case history together with any clinical or laboratory findings promotes the concept of patient-centred care; which in turn drives appropriate, holistic management, as well as a research agenda.

Sub-aim 3: To develop a patient-centered four type model to classify dizzy participants based on symptomatology of common balance disorders.

Development of a patient-centred model

A patient-centred (PRD) model was successfully created which was based on symptoms of common balance disorders. In order to put the patient at the centre of the model, descriptions of dizziness and the definition of the four types of dizziness were linked. The linking of the patient experience and clinical dizziness definitions allowed the patient-centred aspect of the model to be achieved.

The model was designed based on common dizziness symptoms which proved to be problematic in the identification of possible aetiologies in this study's sample (discussed below). The common dizziness symptoms were derived from a body of literature which focused on the diagnosis of dizziness in general populations (Kuo et al., 2008; McCaslin et al., 2008; Clarke, 2010; Dros et al., 2010; Tusa, 2010), but not in specific populations such as the HIV population.

Another aspect of the PRD was its ability to identify possible triggers of dizziness in relation to the type of dizziness. The triggers were established based on the same literature with which symptom and possible aetiologies were derived. The ability of the PRD to identify possible triggers of dizziness is discussed below.

Possible referrals was one more aspect of the PRD algorithm, which again other diagnostic algorithms have not been able to provide. However, the referral aspect of the PRD was not utilised in this study, as possible aetiologies could not be established, and thereby rendering the use possible referrals redundant. The added aspect of possible referrals, which is not strictly a diagnostic feature, was included so as to link the PRD from diagnosis to management.

In spite of the PRD not being completely useable in the current study, its application in different settings such as otology and neurotology rather than in general medical could prove to be better. The PRD may also have possible application in general practice where perhaps knowing possible referral pathways could be very helpful.

Classification of dizzy participants

The PRD algorithm was able to successfully classify the dizzy participants (n=15) into the four types of dizziness by focusing on the participant and their description of dizziness experienced. Classifying dizzy participants into one of the four types of dizziness allowed for narrowing down of

symptoms, which could theoretically, lead toward the identification of specific aetiologies. Previous studies focused on the myriad of symptoms reported by dizzy patients in order to identify pathologies (Kuo et al., 2008; Zhao et al., 2011), which made the diagnostic process more difficult. The PRD, through categorising the dizziness experience by the patient from the beginning of the diagnostic process, narrowed down the possible aetiologies associated with the dizziness experienced. Initial categorising of dizziness experienced by the dizzy patient enabled organized diagnostic pathways to emerge, based on symptoms reported.

Identifying possible aetiologies

The PRD was unable to identify possible aetiologies in the dizzy participants. Inability to identify possible aetiologies by the PRD was attributed to the small sample, as well as the difference of symptoms reported by the participants in this study who were living with HIV. The symptoms reported by the dizzy HIV positive sample of this study varied from the common symptoms of dizziness on which the PRD was based. In addition, a small sample (n=15) of dizzy participants adversely affected the ability of the PRD to identify possible aetiologies; of which the majority fell into the non-specific category of dizziness.

Despite being unable to identify possible aetiologies in this study's sample, the PRD may be able to identify possible aetiologies in populations not living with HIV. The PRD was developed of a body of literature which was based on HIV negative populations, which may be a reason why the identification of possible aetiologies through symptom report was unsuccessful.

The need for information on symptomatology related to dizziness in the HIV population was found to be important as the dizzy participants in this study reported symptoms which did not follow common symptoms of dizziness. The lack of research on symptomatology related to dizziness in HIV populations, adversely affected the development of the PRD, which was designed to address dizziness in PLHIV.

Identifying possible triggers of dizziness

The PRD was able to identify possible triggers of dizziness in the dizzy participants. Three participants (20%) were identified to have peripheral triggers, two participants (13%) having central triggers, one participant (7%) as having a vascular trigger and nine (60%) as having either a psychological and/or situational trigger.

The ability of the PRD to identify the triggers of dizziness without clinical or laboratory assessments is noteworthy; as other symptom based algorithms have not been able to provide possible triggers. However, the PRD is unable to give a definite and undeniable identification of a trigger but rather aims to narrow down the possible triggers, in order for the further clinical and/or laboratory assessments to be conducted and referrals made. The need to utilise clinical and laboratory assessments to confirm the trigger of dizziness was exemplified by the disparity found between the results of the case history and bedside and laboratory assessments of participants like D14; where although non-specific dizziness was reported, vestibular dysfunction was identified by laboratory assessment.

PRD model's utility

The PRD was found to be partially implementable in this study due to the following reasons:

- PRD was able to classify dizzy participants into the four dizziness categories
- PRD was unable to identify possible aetiologies of dizziness
- PRD was able to identify possible triggers of dizziness

Determining whether something is useable is based on its ability to be utilised by a user and whether it performs what it is supposed to do (Rubin & Chrisnell, 2008). Therefore, with regard to the PRD, although it was able to classify dizzy participants into one of the four types of dizziness correctly, it was unable to identify possible aetiologies and was unable to identify undeniable triggers of dizziness. The PRD was able to generate some useful aspects of diagnosis but did not perform as expected. What the PRD is able to do, in essence, is serve as guidance to a clinician, who through audiological diagnosis is able to confirm a diagnosis of dizziness and select appropriate referrals when managing a dizzy patient.

Limitations of Study

Sample size and recruitment.

The major limitation of this study was the small sample size. With a sample size of 32 participants, statistical significance was difficult to establish as there were numerous tests which needed to be correlated. As a result the study was not able to generate any statistically significant results. It is hoped that should this study be replicated with a much larger sample then statistically significant results could emerge which would inform clinical practice in the study populations. Despite the small sample size, what is interesting is the proportion of participants who reported experiencing dizziness, which correlates and surpasses reports of previous studies where 30% of participants experienced dizziness.

Recruitment of participants was found to be difficult due to logistical and consent problems. Recruitment difficulties were experienced as many patients approached regarding joining the study declined to participate (n=48), or cited reasons not to enrol, including fear of stigma, nervousness about assessment procedures and not feeling well. Positive efforts were made to introduce participants to the study through advertising via posters, and nursing and medical staff informing patients about the study. In order to expand the pool of potential participants, permission was sought to recruit at additional sites, but permission was not granted prior to the conclusion of the data collection period.

A possible method of addressing the small sample size would be to link the study either nationally or internationally to facilities that have the expertise, equipment and a large in-patient population. Using in-patients would be an ideal way to reduce attrition. However, in this country (Khoza-Shangase, 2010; Heinze et al., 2011) most of the in-patient population with HIV are co-infected with TB, often MDR, meaning they could have vestibular fall out due to ototoxics.

Implications of the Study

The implications of this study can be viewed from two perspectives, clinical and research. When considering the clinical implications of this study, its limitations and challenges, discussed earlier in this chapter, should be recognised.

Clinical implications.

Based on findings, the following clinical steps are recommended to address the challenges that clinicians and PLHIV are faced with:

1. Due to the lack of standardised categorisation of dizziness, the PRD algorithm was developed based on the body of literature around dizziness, which encompassed the variety of symptoms which dizzy patients report. However, recently there have been efforts to standardise the definition of dizziness categories across medical disciplines (Bisdorff, Von Brevern, Lempert & Newman-Toker, 2009; Newman-Toker, 2012), which may enable easier and definite identification of dizziness types in patients who report dizziness, and not only in HIV population. In addition, with definitions that are uniform across disciplines the dizzy patient will be able to be managed appropriately and effectively.

   Recent literature suggests that there needs to be a shift of focus from symptoms to triggers and duration of dizziness, in order to diagnose dizziness (Newman-Toker, 2012). The current study has shown that the triggers of dizziness are more prevalent than common dizziness symptoms in dizzy participants, which supports the idea of shifting focus from symptomatology.

2. The need for critical evaluation of the current assessment protocol of vestibular function is recommended so as to maximise sensitivity and specificity. By developing and adopting a universal assessment protocols research data will be generated which will allow meta-analysis, which is important in the HIV population as it is plagued with small samples sizes which can be improved by meta-analysis.

Suggestions for future research.

The following research efforts are recommended to address the challenges that clinicians and PLHIV are faced with:

1. To explore the inclusion of situational dizziness into the category of non-specific dizziness. Situational dizziness which is dizziness that results due to hypoglycaemia from not eating, over exertion and non-routine taking of medication, may be classified as non-specific due to the varying causes of dizziness. The category of non-specific should not be used solely for the identification of psychogenic dizziness but for other non-specific dizziness as well, as this study has shown is present in the HIV population.

2. To amend the PRD model so that it accommodates not only common vestibular disorders and their related symptoms but other symptoms which were identified in this study's sample. With a more accommodating and broader model, the PRD's utility could be evaluated more precisely with a larger sample size.

Conclusion

In order to establish a thorough perspective of dizziness experienced by PLHIV, this study employed a methodology that included standard of care namely case history, bedside and laboratory testing. The aim was to investigate the prevalence of dizziness and associated symptoms and explore the nature of dizziness through patient report, clinical and laboratory assessments and a patient-centred model of classification.

Using the patient-centred PRD model, results showed that the almost half (46.9%) of PLHIV experience some form of dizziness however, due to sample size constraints, correlations between case history, clinical and laboratory findings could be not established.

In conclusion, this study has served to describe a snap-shot of dizziness profile in PLHIV, in active, busy hospital HIV clinics. Although significant correlations between findings could not be found, the potential of a thorough protocol for the assessment of dizziness in PLHIV has been highlighted. With almost half of the sample reporting dizziness, the importance of thorough symptom exploration was highlighted. A method of systematic classification (PRD) emerged which could be used in future research to enhance the diagnosis and management of dizziness.

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Appendices

Appendix 1: Participant Letter (English)

Division of Communication Science and Disorders
Department of Health and Rehabilitation Sciences
Faculty of Health Sciences
F45 Old Main Building
Groote Schuur Hospital
Telephone: (021) 406 – 6401
Fax: (021) 406 – 6323
Email: Christine.Rogers@uct.ac.za
Dunay.Taljaard@uct.ac.za

Hello,

My name is Jay Chouhan and I am an Audiologist. I would appreciate it if you could help me with my study by being part of it. The study looks at dizziness and balance in people living with HIV. The information from this study will help doctors know about the different types of dizziness that people living with HIV experience.

The study will have two parts. The first part is where I will give you 2 questionnaires to fill out, by yourself which do not take more than 20 minutes to complete and will ask you some questions about balance and dizziness. During this part of the study I will be note down your medical information which will include your HIV status, the medicines that you are on, any other illness and or surgeries that you may have had in the past.

The second part is where I will ask you to do some things like moving your head in up and down, shaking your head, walking up and down a corridor and stepping on the spot. Some of the tests in the second part require me to look at your eyes and hold your head while I do so. Other tests will involve me asking you to follow my finger with your eyes, moving your legs and hands in different directions and using cotton wool to touch your face to see if you can feel it.

The last thing I will ask you to do is to put on some goggles that have small cameras inside them. The goggles record your eyes. When you have the goggles on I will put some water into your ears. Some people have felt dizzy or nauseous when they have water put in their ears. The feeling is like spinning around in circles or at the playground on a merry-go-round, it lasts about 2 minutes. The dizziness lasts for about 5 minutes after the test but it is not likely that you will feel very sick. This test is very particular and you will need to prepare for it. I will explain how you will need to prepare for the tests. Video recordings of the tests will be made. The recordings will ONLY be used by us to review our testing.

During all parts of the study I will explain the tests to you before we do them. I will make sure you understand the tests and what you need to do and I will help you with the tests by showing what you what to do, if you don't understand.

At any point of the study, if it is found that you require medical attention or management, you will be referred to your doctor. A letter will be given to you that will explain the results and what management you require, that you may give to your doctor.

It should be noted that your help in this study may help you in the future as well as other people living with HIV, who experience dizziness. No money will be given as a reward.

All information that is recorded or obtained from any part of the study will be kept private. Your identity will not be known to anyone besides the researchers in the study. All information will be kept safe and access to the information will be restricted. Only the researchers will have access to your information.

At any point of the study, if it is found that you require medical attention or management, you will be referred to your doctor. A letter will be given to you that will explain the results and what management you require, that you may give to your doctor.

You have the right to and are allowed to leave this study at any time without having to tell us why. You will only have to inform the researchers that you would like to leave the study, before you do, so that we know that you do not want to continue.

Please feel free to ask me any questions that you may have. If there is anything you don't understand I am willing to explain it to you. You may contact the following people:

Jay Chouhan Christine Rogers Dr. Dunay Taljaard

Thank you,

Jay Chouhan (BSc Audiology)

Appendix 2: Participant Consent Form (English)

University of Cape Town
Department of Communication Sciences and Disorders

PARTICIPANT CONSENT FORM

Participant: _____

- ☐ I understand what the study is about.
- ☐ I had a chance to ask questions.
- ☐ My questions were answered.
- ☐ I understand the tests in the study.
- ☐ I made the decision to be part of the study by myself.
- ☐ I know that any information about me will be kept private, secret and unidentifiable.
- ☐ I know that I can leave this study at any time that I want to.

SIGNED: _____ WITNESS: _____

ALTERNATE SIGNATURE:

DATE: _____

Appendix 3: Participant Consent Form (Afrikaans)

Universiteit van Kaapstad

Department van Komunikasie Wetenskap en Versteurings

DEELNEMER KONSENT VORM

Deelnemer: _____

☐ Ek verstaan waaroor die studie gaan.

☐ Ek het ‘n kans gehad om vraë te vra.

☐ My vraë het antwoord gewees.

☐ Ek verstaan al die toetse in die studie.

☐ Ek het besluit myself om deel van die studie te wees.

☐ Ek weet dat enige inligting oor my sal privaat en n geheim wees.

☐ Ek weet dat ek hierdie studie na kan laat as ek wil.

HANDTEKENING: _____ GETUIE: _____

PLAAS VERVANGERS HANDTEKENING: ☐

DATUM: _____

Appendix4: Participant Consent Form (isiXhosa)

University of Cape Town

Department of Communication Sciences and Disorders

IFOMU YESIVUMELWANO YOKUTHABATHA-INXAXHEBA

UMthabathi - nxaxheba: _____

☐ Ndiyasiqonda ukuba isifundo singantoni na.

☐ Ndibe nalo ithuba lokubuza imibuzo.

☐ Imibuzo yam iphendulwe.

☐ Ndiyaziqonda iimvavanyo kwisifundo.

☐ Ndenze isigqibo ngokwam sokuba yinxalenye yesi sifundo.

☐ Ndiyayazi into yokuba nayiphi na ingcaciso emalunga nam iya kugcinwa iyimfihlo, ilihlebo yaye ingenakho ukwayanyaniswa nam.

☐ Ndiyayazi into yokokuba ndingasishiya esi sifundo nangaliphi na ixesha ndifuna.

UTYIKITYO: _____ INGQINA: _____

UTYIKITYO OLULOLUNYE: ☐

UMHLA: _____

Appendix 5: Case history data sheet

Hospital ID:	**CASE HISTORY DATA SHEET**					
Research ID:			**SEX**	**Male**		
DATE OF BIRTH				**Female**		
LANGUAGE	**English**	**Afrikaans**	**Xhosa**	**Other**		
HIV STATUS	**1**	**2**	**3**	**4**		
ARVs	**Yes**	**No**	**Viral Load:**	**CD4 Count:**		
Duration of Treatment (years)	**Less than 1**	**1 to 5**	**5 to 10**	**10 or more**		
Which ARVs						
	Stavudine (d4T)		**Zindovudine (AZT)**	**Tenofir**		
	Lamivudine (3TC)		**Didanosine (ddI)**			
	Efavirenz (EFV)		**Lopinavir (LPV)**			
	Nevirapine (NVP)		**Ritonavir (r)**			
OTHER MEDS						
EAR/HEAD/NECK SURGERY	**Yes**	**No**				
	Yes	**No**				
Dysphagia						
Diplopia						
Dysarthria						
Dysmmetria						
DIZZINESS EXPERIENCE			**Self-Spinning**	**Dysequilibrium**	**Falling**	**Room spinning**
				Nausea	**Vomiting**	**Blackout**
Aggravating factors						
Relieving factors						
Onset	**Before HIV**	**After HIV**				

Episode/s of dizziness	**Yes**	**No**	**In last 12 months**	**1-5 years ago**	**5-10 years ago**		
Number of episodes	**Less than 5**	**5 to 10**	**10 or more**	**Duration of episodes**	**Seconds**	**Minutes**	**Hours**
SELF REPORTED HEARING STATUS	**Normal**	**Abnormal**	**Unilateral**	**Bilateral**	**Fluctuating**	**Stable**	
			L **R**				
Hearing Loss Onset	**Before HIV**	**After HIV**					
Other auditory symptoms	**Tinnitus**	**Fullness**	**Pain**				
HEADACHES	**Yes**	**No**					
OTHER MEDICAL CONDITIONS							

Appendix 6: Vertigo Symptom Scale - English

VERTIGO SYMPTOMS SCALE

Instructions:

Please put an X the appropriate box to indicate how many times you have experienced each of the symptoms listed below during the last 12 months (or since the vertigo started, if you have had vertigo for less than one year).

Range of responses:

0	1	2	3	4
Never	**A few times (1-3 times a year)**	**Several times (4-12 times a year)**	**Quite often (on average, more than once a month)**	**Very often (on average, more than once a week)**

How often **in the past 12 months** have you had the following symptoms:	Never	A few times (1-3 times a year)	Several times (4-12 times a year)	Quite often (on average, more than once a month)	Very often (on average, more than once a week)
1. A feeling that things are spinning or moving around, lasting;					
a) – less than 2 minutes	0	1	2	3	4
b) – up to 20 minutes	0	1	2	3	4
c) – 20 minutes to 1 hour	0	1	2	3	4
d) – several hours	0	1	2	3	4
e) – more than 12 hours.....	0	1	2	3	4
2. Pains in the heart or chest region	0	1	2	3	4
3. Hot or cold spells	0	1	2	3	4
4. Unsteadiness so severe that you actually fall	0	1	2	3	4
5. Nausea (feeling sick), stomach churning	0	1	2	3	4
6. Tension/soreness in your muscles	0	1	2	3	4
7. A feeling of being light-headed, "swimmy" or giddy, lasting;					

a) – less than 2 minutes	0	1	2	3	4
b) – up to 20 minutes	0	1	2	3	4
c) – 20 minutes to 1 hour	0	1	2	3	4
d) – several hours	0	1	2	3	4
e) – more than 12 hours.....	0	1	2	3	4
8. Trembling, shivering	0	1	2	3	4
9. Feeling of pressure in the ear(s)	0	1	2	3	4
10. Heart pounding or fluttering	0	1	2	3	4
11. Vomiting	0	1	2	3	4
12. Heavy feeling in arms or legs	0	1	2	3	4
13. Visual disturbances (e.g. blurring, flickering, spots before eyes)	0	1	2	3	4
14. Headache of feeling of pressure in the head	0	1	2	3	4
15. Unable to stand or walk properly without support	0	1	2	3	4
16. Difficulty breathing, short of breath	0	1	2	3	4
17. Loss of concentration or memory	0	1	2	3	4
18. Unsteady on your feet, trying to balance, lasting;					
a) – less than 2 minutes	0	1	2	3	4
b) – up to 20 minutes	0	1	2	3	4
c) – 20 minutes to 1 hour	0	1	2	3	4
d) – several hours	0	1	2	3	4
e) – more than 12 hours.....	0	1	2	3	4
19. Tingling, pins and needles or paralysis in parts of the body	0	1	2	3	4
20. Pain in your lower back area	0	1	2	3	4
21. Excessive sweating	0	1	2	3	4
22. Feeling faint, losing consciousness	0	1	2	3	4

Appendix 7: VSS – Afrikaans

AFRIKAANSE VERTIGO SIMPTOME SKAAL

Instruksies:

Omkring asseblief die gepaste nommer om aan te toon ongeveer hoeveel keer jy die volgende simptome, op die lys, ervaar het **gedurende die laaste 12 maande** (of sedert die duiseligheid begin het, indien jou duiseligheid minder as 'n jaar gelede begin het). Die verskeidenheid van keuses is:

0	1	2	3	4
Nooit	**Enkele Kere (1 – 3 maal ń jaar)**	**Verskeie kere (4 – 12 maal ń jaar)**	**Redelik gereeld (gemiddeld, meer as een maal per maand)**	**Baie gereeld (gemiddeld, meer as een maal per week)**

Hoe gereeld **gedurende die afgelope 12 maande** het jy die volgende simptome gehad:	**Nooit**	**Enkele Kere (1 – 3 maal ń jaar**	**Verskeie kere (4 – 12 maal ń jaar**	**Redelik gereeld (gemiddeld, meer**	**Baie gereeld (gemiddeld, meer**
1. 'n Gevoel dat alles draai of in die rondte beweeg, vir 'n tydperk van: **[beantwoord asseblief a) tot e)]**					
a) – minder as 2 minute	0	1	2	3	4
b) – tot en met 20 minute	0	1	2	3	4
c) – 20 minute tot 1 uur	0	1	2	3	4
d) – 'n aantal ure	0	1	2	3	4
e) – meer as 12 ure	0	1	2	3	4
2. Pyne in die hart of bors area	0	1	2	3	4
3. Warm of koue gloede	0	1	2	3	4
4. Onvas op jou voete, so erg dat jy omval	0	1	2	3	4
5. Naarheid (siek voel), 'n draai gevoel in die maag	0	1	2	3	4
6. Spanning / seerheid in jou spiere	0	1	2	3	4
7. 'n Gevoel van lighoofdigheid, 'n gevoel van "swewing" of duiseligheid, vir 'n tydperk van: **[beantwoord asseblief a) tot e)]**	0	1	2	3	4

a) – minder as 2 minute	0	1	2	3	4
b) – tot en met 20 minute	0	1	2	3	4
c) – 20 minute tot 1 uur	0	1	2	3	4
d) – 'n aantal ure	0	1	2	3	4
e) – meer as 12 ure	0	1	2	3	4
8. Bewerigheid, rillings	0	1	2	3	4
9. 'n Gevoel van drukking in die oor / ore	0	1	2	3	4
10. Hartkloppings of –versnellings	0	1	2	3	4
11. Braking	0	1	2	3	4
12. 'n Swaar gevoel in die arms of bene	0	1	2	3	4
13. Visuele versteurings (bv. dofheid, flikkering, kolle voor die oë)	0	1	2	3	4
14. Hoofpyn of 'n gevoel van drukking in die kop	0	1	2	3	4
15. Onvermoeë om behoorlik, sonder ondersteuning, te staan of te stap	0	1	2	3	4
16. Moeilike asemhaling, kortasem	0	1	2	3	4
17. Verlies van konsentrasie of geheue	0	1	2	3	4
18. Onvas op jou voete, besig om balans te verloor, vir 'n tydperk van: **[beantwoord asseblief a) tot e)]**					
a) – minder as 2 minute	0	1	2	3	4
b) – tot en met 20 minute	0	1	2	3	4
c) – 20 minute tot 1 uur	0	1	2	3	4
d) – 'n aantal ure	0	1	2	3	4
e) – meer as 12 ure	0	1	2	3	4
19. Tinteling, prikkeling of lamheid in dele van die liggaam	0	1	2	3	4
20. Pyne in jou laerug area	0	1	2	3	4
21. Oormatige sweet	0	1	2	3	4
22. Voel flou, besig om bewussyn te verloor	0	1	2	3	4

Appendix 8: VSS – isiXhosa

VERTIGO SYMPTOMS SCALE

Imiyalelo:

Nceda ufake X kwibhokosi efanelekileyo ukubonisa ukuba mangaphi na amaxesha othi uzive unolunye lwezi mpawu zidweliswe ngasezantsi <u>kwisithuba seenyanga ezili-12 ezidlulileyo</u> (okanye ukususela okokoko ivertigo iqalisiwe, ukuba ngaba ube nayo ivertigo isithuba esingaphantsi konyaka omnye).

Uluhlu lweempendulo:

0	1	2	3	4
Andizange	**Amaxesha ambalwa (1-3 amaxesha ngonyaka)**	**Amaxesha amaninzi (4-12 amaxesha ngonyaka)**	**Kaninzi (ngokomndilili, ngaphezulu kwesithuba esinye ngenyana)**	**Kaninzi kakhulu (ngokomndilili ngaphezulu kwexesha elinye ngeveki)**

Ube nezi mpawu zilandelayo kangaphi **kwezi nyanga zili-12 zidlulileyo**:	**Andizange**	**Amaxesha ambalwa (1-3**	**Amaxesha amaninzi (4-12**	**Kaninzi (ngokomndilili,**	**Kaninzi kakhulu**
1. Imvakalelo yokungathi izinto ziyajikeleza okanye ziyashukuma, ethatha:					
a) – ngaphantsi kwemizuzu emi-2	0	1	2	3	4
b) – ukuya kutsho kwimizuzu engama- 20	0	1	2	3	4
c) – ama-20 emizuzu ukuya kwiyure e-1.....	0	1	2	3	4
d) – iiyure ezininzi	0	1	2	3	4
e) – ngaphezulu kweeyure ezili-12.....	0	1	2	3	4
2. Iingqaaqmbo kwintliziyo okanye kummandla wesifuba	0	1	2	3	4
3. Amaxesha okuziva ushushu okanye ugodola	0	1	2	3	4
4. Ukungemi nkqi kubi kakhulu kangangokuba ude uwe	0	1	2	3	4
5. Isizaphu-zaphu (uziva ugula), isisu siyaxuxuzela	0	1	2	3	4
6. Ukuxhalaba/ukuqina kwezihlunu	0	1	2	3	4
7. Ukuziva unesizunguzane esingapheliyo; sithatha					

a) – ngaphantsi kwemizuzu emi-2.....	0	1	2	3	4
b) – ukuya kutsho kweimzuzu engama-20	0	1	2	3	4
c) – imizuzu engama-20 ukuya kwuyre e-1	0	1	2	3	4
d) – iiyure ezininzi.....	0	1	2	3	4
e) – ngaphezulu kweeyure ezili-12.....	0	1	2	3	4
8. Uyangcacazela, uyagodola	0	1	2	3	4
9. Uva uxinzelelo ezindlebeni	0	1	2	3	4
10. Intliziyo yakho ibetha ngamandla okanye iyandandazela	0	1	2	3	4
11. Uyagabha	0	1	2	3	4
12. Uziva unobunzima apha ezingalweni nasemilenzeni	0	1	2	3	4
13. Ukubona kwakho kuyaphazamiseka (uma. Ubona luzizi, kuyamenyezela. Ubona amachaphaza)	0	1	2	3	4
14. Intloko ebuhlungu okanye uva uxinzelelo entloko	0	1	2	3	4
15. Akukwazi ukuma okanye ukuhamba ngendlela eyiyo ungaxhaswa	0	1	2	3	4
16. Unobunzima bokuphefumla, unephika	0	1	2	3	4
17. Ingqondo yakho ayizinzanga okanye ukulahlekwa kukukhumbula	0	1	2	3	4
18. Akuzinzanga ukuba ungazimela nkqo, kuthatha;					
a) – ngaphantsi kwemizuzu emi- 2	0	1	2	3	4
b) – ukuya kutsho kwimizuzu engama-20.....	0	1	2	3	4
c) – imizuzu engama-20 ukuya kwiyure e-1	0	1	2	3	4
d) – iiyure ezininzi	0	1	2	3	4
e) – ngaphezulu kweeyure ezili-12	0	1	2	3	4
19. Ukuntlontlozela, iinaliti, okanye ukoma kwamalungu emzimbeni	0	1	2	3	4
20. Iingqaqambo kumazantsi esinqe	0	1	2	3	4
21. Ukubila kakhulu	0	1	2	3	4
22. Ukuziva uza kuwa isiqaqa	0	1	2	3	4

Appendix 9: Dizziness Handicap Inventory – English

Gender	Male		Female	

Jacobson & Newman (1990)

THE DIZZINESS HANDICAP INVENTORY

Please complete the following questionnaire and mark your answer with an X.	YES	SOMETIMES	NO
1. Does looking up increase your problem?			
2. Because of your problem, do you feel frustrated?			
3. Because of your problem, do you restrict your travel for business or recreation?			
4. Does walking down the aisle of a supermarket increase your problem?			
5. Because of your problem, do you have difficulty getting into or out of bed?			
6. Does your problem significantly restrict your participation in social activities such as going out to dinner, going to movies, dancing, or to parties?			
7. Because of your problem, do you have difficulty reading?			
8. Does performing more ambitious activities like sports, dancing, household chores such as sweeping or putting dishes away increase your problem?			
9. Because of your problem, are you afraid to leave home without having someone with you?			
10. Because of your problem, have you been embarrassed in front of others?			
11. Do quick movements of your head increase your problem			
12. Because of your problem, do you avoid heights?			
13. Does turning over in bed increase your problem?			
14. Because of your problem, is it difficult for you to do strenuous housework or yard work?			
15. Because of your problem, are you afraid people may think you are intoxicated			
16. Because of your problem, is it difficult for you to go for a walk by yourself?			
17. Does walking down a sidewalk increase your problem?			
18. Because of your problem, is it difficult for you to concentrate?			
19. Because of your problem, is it difficult for you to go for a walk around your house in the dark?			
20. Because of your problem, are you afraid to stay home alone?			
21. Because of your problem, do you feel handicapped?			
22. Has your problem placed stress on your relationship with members of your family or friends?			
23. Because of your problem, are you depressed?			
24. Does your problem interfere with your job or household responsibilities?			
25. Does bending over increase your problem?			

Appendix 10: DHI – Afrikaans

THE DIZZINESS HANDICAP INVENTORY – AFRIKAANS TRANSLATION (DHI-A)

Vul asseblief die volgende vraelys in en merk u antwoord met 'n **X**.	JA	SOMTYDS	NEE
1. Indien u opkyk, vererger dit u balaans probleem?			
2. As gevolg van u balaans probleem, voel u gefrustreerd?			
3. Beperk u u besigheidsreise of ontspanningsreise as gevolg van u balaans probleem?			
4. Indien u in 'n supermark se gang af loop, vererger dit u balaans probleem?			
5. Is dit vir u moeilik om in of uit die bed te klim as gevolg van u balaans probleem?			
6. Veroorsaak u balaans probleem vir u 'n beduidende probleem met u deelname aan sosiale aktiwiteite bv. Om te gaan uiteet, om te gaan fliek, dans of om na partytjies te gaan?			
7. As gevolg van u balaans probleem sukkel u om te lees?			
8. Indien u meer ambisieuse aktiwiteite soos sport, dans, huishoudelike take (bv. die vloer uit te vee of om borde weg te pak) uitvoer, vererger dit u balaans probleem?			
9. As gevolg van u balaans probleem is u bang om u huis te verlaat sonder om iemand by u te hê?			
10. As gevolg van u balaans probleem was u al in die verleentheid gestel voor ander mense?			
11. Vererger vinnige kopbewegings u balaans probleem?			
12. As gevolg van u balaans probleem, vermy u hoogtes?			
13. Indien u omdraai in die bed, vererger dit u balaans probleem?			
14. As gevolg van u balaans probleem, is dit moeilik om harde huiswerk of tuinwerk te doen?			
15. As gevolg van u balaans probleem, is u bang dat mense sal dink dat u onder die invloed van alkohol is?			
16. As gevolg van u balaans probleem, is dit moeilik vir u om op u eie te loop?			
17. Indien u op 'n sypadjie loop, vererger dit u balaans probleem?			
18. As gevolg van u balaans probleem, vind u dit moeilik om te konsentreer?			
19. As gevolg van u balaans probleem, vind u dit moeilik om in u huis in die donker rond te stap?			
20. As gevolg van u balaans probleem, is u bang om alleen by die huis te bly?			
21. As gevolg van u balaans probleem, voel u gestremd?			
22. Het die balaans probleem stres op u verhoudings met u familie of vriende geplaas?			
23. As gevolg van u balaans probleem, is u depressief?			
24. Meng u balaans probleem in met u werk of huishoudelike verantwoordelikhede?			
25. Indien u vooroor buk, vererger dit u balaans probleem?			

Appendix 11: DHI- isiXhosa

ULUHLU LWEZITHINTELO ZESIYEZI

Nceda uzalise olu luhlu lwemibuzo lulandelayo ze uphawule impendulo yakho ngo-X.	EWE	NGAMANYE AMATHUBA	HAYI
1. Ingaba ukujonga phezulu kuyayandisa ingxaki yakho?			
2. Ngenxa yengxaki yakho, uziva unxunguphele?			
3. Ngenxa yengxaki yakho, ingaba uyaluminya na uhambo lwakho loshishino okanye lokuzonwabisa?			
4. Ingaba ukuhamba kwiipaseji zevenkile yokuthenga kuyayandisa ingxaki yakho?			
5. Ngenxa yengxaki yakho, ingaba unobunzima bokukhwela nokuhla ebhedini?			
6. Ingaba ingxaki yakho iya kuminya kakhulu ukuba uthabathe inxaxheba kwimisebenzi yentlalo efana nokuzikhupha uyokutya kwenye indawo, ukuya kumboniso bhanya-bhanya, kumdaniso okanye kwiipati?			
7. Ngenxa yengxaki yakho, ingaba uba nobunzima bokufunda?			
8. Ingaba ukwenza imisebenzi efana nemidlalo, ukudanisa nomsebenzi wendlu efana nokutshayela, okanye ukubeka izitya kwiindawo zazo kuyayandisa na ingxaki yakho?			
9. Ngenxa yengxaki yakho, ingaba uyoyika ukuphuma ekhaya ungenamntu uhamba naye?			
10 Ngenxa yengxaki yakho , ube nokuhlazeka phambi kwabanye abantu?			
11. Ingaba ukukhawuleza ushukume kuyayandisa ingxaki yakho?			
12. Ngenxa yengxaki yakho , uyaziphepha iindawo eziphakamileyo?			
13. Ingaba ukuguquka ebhedini kuyayandisa ingxaki yakho?			
14. Ngenxa yengxaki yakho , ingaba kunzima kuwe ukwenza umsebenzi onzima wasekhaya okanye weyadi?			
15. Ngenxa yengxaki yakho , ingaba uyayoyika into yokokuba abantu bacinge ukuba unxilile?			
16. Ngenxa yengxaki yakho , ingaba kunzima na kuwe ukuhamba wedwa ngokukhululekileyo?			
17. Ingaba ukuhamba kwindledlana esecaleni lomgaqo kuyayandisa ingxaki yakho?			
18. Ngenxa yengxaki yakho ,ingaba kunzima ukuzikisa ingqondo?			
19. Ngenxa yengxaki yakho , ingaba kunzima kuwe ukuhamba ujikeleza emzini			

wakho ebumnyameni?			
20. Ngenxa yengxaki yakho , ingaba uyoyika ukuhlala ekhaya wedwa?			
21. Ngenxa yengxaki yakho , ingaba uziva unesithintelo?			
22. Ingaba ingxaki yakho sele ibeke uxinzelelo olukhulu kubudlelwane bakho namalungu osapho lwakho okanye abahlobo?			
23. Ngenxa yengxaki yakho , ingaba udakumbile?			
24. Ingaba ingxaki yakho iphazamisana nomsebenzi wakho okanye uxanduva lwakho lwasendlwini?			
25. Ingaba ukugoba kuyayandisa ingxaki yakho?			

Appendix 12: Bedside assessment sheet

Hospital ID:										
Research ID:										
Otoscopy	**Normal**									
	Abnormal:									
Audiometry	**Left ear**		**Right ear**							
		PTA								
		Configuration								
		Severity								
Tympanometry	**Type A**	**Type B**	**Type C**							
Spontaneous Nystagmus			**Abnormal**					**Direction of Fast Phase**		
			Jagged	**Fine**	**Erratic**	**Coarse**	**Rebound**	**Right**	**Left**	
Right eye	**with fixation**									
	without fixation									
Left eye	**with fixation**									
	without fixation									
Gaze	**eccentric position**	**Right**								
		Left								
		Up								
		Down								
Pupil Reflex		**Normal**	**Abnormal**							
	Right eye									
	Left eye									
Corneal Reflex	**Normal**	**Abnormal**								
Saccades	**Hypermetria**	**Hypometria**	**Normal**							
Smooth Pursuit Horizontal	**Normal**	**Abnormal**								

Vestibular Oculo Reflex							
Head Shake	**Nystagmus**						
	Yes	**No**					
	Direction of saccade	**Right**	**Left**				
Head Thrust	**Saccades**						
	Yes	**No**					
	Direction of fast phase	**Right**	**Left**				
Dynamic Visual Acuity	**Normal**	**Abnormal**					
	(Drop of more than 2 lines from baseline in best-corrected vision)						
Hyperventilation	**Nystagmus**		**Anxiety Alert**				
	Yes	**No**	**Yes**	**No**			
	Direction of fast phase	**Right**	**Left**				
Cranial Nerves							
I	Subjective Sense of Smell	Normal		**VIII**	Cochlear Part	Audiometry	
		Abnormal			Vestibular Part	Head Shake, head thrust, nystagmus	
II	Pupil Reflex		TESTED	**IX**	Sense of taste	Normal	Abnormal
III	Pupil Reflex		TESTED				
IV	Pupil Reflex, saccades, smooth pursuit		TESTED	**X**	Swallowing	Normal	Abnormal
V	Corneal Reflex		TESTED				
VI	Lateral Movement of eye		TESTED	**XI**	Dysarthria		
VII	Sense of touch on face & motor function	Normal		**XII**	Tongue movement & dysarthria		
		Abnormal					

Cerebellar	**Normal**	**Abnormal**	
Finger to Nose			

Heel to Shin				
Supinating and Pronating				
Dynamic Gait Index	**Score**			
Vestibular Spinal Reflex				
Romberg	**Standard**			
		Normal	**Abnormal**	
	Eyes open			
	Eyes closed			
	Sharpened			
		Normal	**Abnormal**	
	Eyes open			
	Eyes closed			
Modified CTSIB: 4 conditions 30 seconds each			**<30 seconds: duration**	**Movement:**
	Firm Surface	**Eyes Open**		
		Eyes Closed		
	Foam Surface	**Eyes Open**		
		Eyes Closed		
Dix Hallpike Manoeuvre	**Normal**		**Abnormal**	
	Left: nystagmus/vertigo		**Right; nystagmus/vertigo**	
	Latency		**Latency**	
	Fatigability		**Fatigability**	
	Direction of nystagmus		**Direction of nystagmus**	
	Clockwise	**Counter clockwise**	**Clockwise**	**Counter clockwise**
	BPPV Diagnosis: posterior canal			
		Yes	**No**	
	Right			
	Left			

Appendix 13: Videonystagmoghraphy

Videonystagmography

Videonystagmography is a computerised, non-invasive diagnostic test that utilises goggles that the participant wears, to assess eye-movements based on the corneoretinal potential (Gans & Yellin, 2007). The goggles have two infrared cameras that function as two way mirrors that reflect the infrared light and allow the participant to see normally (Roeser et al., 2007). Algorithms enable the camera recordings to be analysed by the computer, producing visualization of the eye movements on screen. The cameras record the eye movements of the participant in the horizontal and vertical planes. The recorded eye-movements can be seen as two dimensional images and videos on the computer, online and offline. VNG has begun to replace the standard electro-nystagmography (ENG) technique and has been implemented as the standard diagnostic assessment in many clinics around the world (BSA, 2010).

ENG uses electrodes and cameras to assess the vestibular assessment (Shepard 2009). With the development in technology the VNG provides several advantages over the ENG techniques (Gans & Yellin, 2007). Firstly, it allows for observation and recording of eye movements, with independent evaluation of each eye separately. Second, the time taken for patient preparation is reduced due to lack of electrodes. Third, calibration is made easier compared to ENG as there are no electrodes and computerised calibration is possible. Four, the patient is not required to close their eyes and the test room environment does not have to be darkened. Five, VNG can be used in the paediatric population. Six, correlation between actual eye movements and graphic algorithm analysis is possible through the computerised display. Seven, artefacts are reduced during testing (Gans & Yellin, 2007; Shepard, 2009).

However, there are disadvantages with VNG. These disadvantages include the goggles being heavy and slightly uncomfortable, patientss with darkened make-up (permanent) or dark eye lashes as well as droopy eyelids are not suitable to testing (Gans & Yellin, 2007). Overall it can be said that VNG is more participant friendly than ENG.

VNG is similar to the bedside assessment as it evaluates the VOR as well as oculo-motor function. The VNG software allows for the results of the tests to be recorded and analysed by the use of algorithms and graphical representation of the results. The tests that are conducted in the VNG assessment follow the same procedures as in the bedside assessment. The tests involved in the VNG assessment include the following:

Oculo-motor (spontaneous and gaze)

Head shake

Hyperventilation

Dix-Hallpike Manoeuver

VNG provides additional, quantitative information which, when combined with the bedside assessment, allows for more accurate site-of-lesion determination. The ability of the VNG to record eye movements enables closer and improved evaluation of nystagmus during different tests. In addition, stored recordings allow for inter- and intra-rater reliability measures to be calculated.

Bi-thermal caloric irrigation

The lateral semi-circular canal (Goncalves, Felipe & Lima, 2008) was stimulated by introducing water into the external auditory meatus. The stimulation allows for the lateral identification of a weak labyrinth (Goncalves et al., 2008). Warm and cold water is used as stimuli, with the deviation of 7° Celsius from average body temperature of 37°Celsius (BSA, 2010). The water is irrigated at a rate of 500ml per minute, for 30 seconds (BSA, 2010).

Otoscopy is conducted to ensure occlusion of the EAM was absent. Patients are positioned supine with their head elevated 30° from the horizontal plane, with VNG goggles in place. The delivery tube was measured to the patient s' EAM length to ensure optimal stimulation occurred and to avoid incorrect and painful placement of the delivery tube. Patients are mentally alerted and informed of when the water is to be irrigated.

Irrigation begins with cold water at the above mention rate. The VNG recording system is activated upon commencing irrigation. Patients are kept mentally alerted throughout irrigations. A five minute break is provided to ensure any dizziness has subsided and the patient is ready for the opposite ear to be irrigated with cold water.

Once cold water irrigation has been conducted on both ears, a fifteen minute break is given to allow the ears to return to body temperature and to allow any dizziness to subside. Warm water irrigation then proceeds, following the same steps as cold water irrigation.

Observations are made for caloric perversion and inversion. A correction factor is utilised for the calculations in cases where spontaneous nystagmus is present (BSA, 2010).

Appendix 14: VNG equipment – GN Otometrics ICS Chartr 200

http://www.otometrics-extranet.com/products/ba/vng_eng/chartr200.htm

http://www.otometrics-extranet.com/products/ba/vng_eng/chartr200.htm

Appendix 15: University of Cape Town Human Research Ethic Committee approval letter

UNIVERSITY OF CAPE TOWN

Health Sciences Faculty
Human Research Ethics Committee
Room E52-24 Groote Schuur Hospital Old Main Building
Observatory 7925
Telephone [021] 406 6338 • **Facsimile** [021] 406 6411
e-mail: shuretta.thomas@uct.ac.za

07 October 2011

HREC REF: 458/2011

Mr J Chouhan
c/o Ms C Rogers
Division of Communication & Science Disorders
Health & Rehab
OMB

Dear Mr Chouhan

PROJECT TITLE: THE PREVALENCE AND NATURE OF VERTIGO IN DIZZY ADULTS LIVING WITH HIV ATTENDING A TERTIARY HIV CLINIC IN THE WESTERN CAPE.

Thank you for submitting your study to the Faculty of Health Sciences Human Research Ethics Committee for review.

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

Approval is granted for one year till the 28 October 2012.

Please submit a progress form, using the standardised Annual Report Form (FHS016), if the study continues beyond the approval period. Please submit a Standard Closure form (FHS010) if the study is completed within the approval period.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please quote the HREC. REF in all your correspondence.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, HSF HUMAN ETHICS
Federal Wide Assurance Number: FWA00001637.

s.thomas

Appendix 16: Superintendents' approval letters - Groote Schuur Hospital

DEPARTMENT of HEALTH
Provincial Government of the Western Cape

GROOTE SCHUUR HOSPITAL
bpatel@pgwc.gov.za
Tel. 021-404 6288
Private Bag, Observatory, 7935
www.capegateway.gov.za

REFERENCE:
ENQUIRIES: Dr BHAVNA PATEL

Jay Chouhan
Division of Communication Science and Disorders
School of Health and Rehabilitation Sciences
Faculty of Health Sciences
F45 Old Main Building
Groote Schuur Hospital

Dear Mr Chouhan

RE: Research at Groote Schuur Hospital for Master's Degree in Audiology

Your recent letter to the hospital refers.

You are hereby granted permission to proceed with your research.

Please note the following:

a) Your research may not interfere with normal patient care
b) Hospital staff may not be asked to assist with the research.
c) No hospital consumables and stationary may be used
d) Please introduce yourself to the person in charge of an area before commencing.

I would like to wish you every success with the project.

Yours sincerely

Patel

Dr Bhavna Patel
Chief Operational Officer
Date: 13 October 2011

Appendix 17: VNG pre-assessment instructions

PRE-ASSESSMENT INSTRUCTIONS

This test is designed to help find the source of dizziness or balance problems. You will wear video goggles to measure eye movements. The test consists of three parts. First, you will be asked to watch a series of lights on a light bar. Next, you will be asked to lie in different positions. Finally, warm and cool water will be put into your ears to measure eye movements. The test will take approximately 1 to 1 ½ hours. *These tests are not painful. However, you may feel dizzy after the test but it will go away after a few minutes.*

PLEASE READ CAREFULLY:
Certain medicines may change the findings of the tests. Please **stop taking them** for the stated amount of time before your appointment:

DO NOT take any anti-dizziness or anti-nausea medication at ANY TIME BEFORE the assessment. Medicines such as Stemetil, Betahistine, Meclizine, Dimenhydrinate, Chonazepam, Diazepam, Lorazepam, Granisetron, Metoclopramine, Ondensetron, Prochlorperazine, Promethazine, Buclizine and Cyclizine etc. I will look at your medicine chart and tell you what you should stop taking.

3 Full days before the test:
Do not take any sleeping pills, tranquilizers, pain medication or other drugs (TIK, cocaine, ecstasy, marijuana etc.) or medications which contain any of the above.

48 Hours:
Do not take any alcoholic beverages, non-essential medications, antihistamines and over-the counter cold or allergy medications.

VERY IMPORTANT:
Please **CONTINUE** with medicines for your heart, blood pressure, diabetes, thyroid, seizures or any other chronic illnesses and **your ARVs.**

ALSO:
Do not eat or drink anything for a period of three (3) hours before the time of the test.
Do not have any substance with caffeine (coffee, cola, tea, chocolate, etc) or smoke **on the day of the test**.
Do not wear any mascara, foundation, face cream or hair gel **on the day of the test and** if possible do not wear contact lenses.

Date & Day of Appointment:_____ Participant Signature:_____

Thank you,
Jay Chouhan
(Audiologist) **Tel: 0792506937**

Email: jay.chouhan@uct.ac.za

Appendix 18: Superintendent Information Letter

Division of Communication Science and Disorders
Department of Health and Rehabilitation Sciences
Faculty of Health Sciences
F45 Old Main Building
Groote Schuur Hospital
Telephone: (021) 406 – 6401
Fax: (021) 406 – 6323
Email: Christine.Rogers@uct.ac.za
Dunay.Taljaard@uct.ac.za

Dear Dr. Patel,

Re: Research at Groote Schuur Hospital for Master's Degree in Audiology

I am an Audiologist, currently pursuing a Master's Degree in Audiology, at the University of Cape Town. As a requirement for completion of my degree, it is necessary that I carry out a research project.

I request permission to conduct research at your hospital. This research is aimed at describing the prevalence and nature of dizziness, specifically vertigo, in an adult population living across the spectrum of HIV. I hope to conduct my research at Groote Schuur Hospital's HIV Clinic and the Audiology Unit and this is where UCT's equipment is located.

For my study I intend to review patient medical folders, conduct a case history specific to vestibular function, administer two self-assessment questionnaires and conduct vestibular bedside tests as well videonystagmography testing. The folders involved will be of those patients who have been diagnosed as being HIV positive at the Groote Schuur Hospital's HIV Clinic, regardless of their CD4 count. It must be noted that I am aware of the pressing issues of patient (and clinician) confidentiality and will take every measure possible to ensure that data is kept anonymous.

I therefore request permission to access your medical records for the patients who have been diagnosed as being HIV positive at the Groote Schuur HIV Clinic and permission to approach the patients at your hospital in order to obtained case histories, administering self-assessment questionnaires, conducting vestibular function assessment and reviewing the patients' medical folders.

I have considered potential burdens to your staff and inconveniences that may result from the conduction of my research. The study does not require any assistance from medical staff in obtaining case history information, administering the self-assessment questionnaires. However, a private area will be required in the HIV clinic in order for private and confidential data collection to be obtained from the participants, which will be negotiated upon the granting of permission. During the vestibular assessments, a doctor or nurse may be required to administer antiemetic drugs to the participants during the assessments, as the caloric tests in the assessments may elicit nausea and vomiting. Assistance from the doctor or nurse will only be required in the event of

intractable vomiting, as vomiting is highly unlikely to occur. To address this potential service provision limitation, I propose to conduct the vestibular assessment when there is a doctor on duty at the Out Patients Department, which will be negotiated with the Otolaryngology staff.

I have obtained ethical clearance; reference no.: 458/2011. If you have any queries or concerns, please contact my supervisors, Christine Rogers or Dr. Dunay Taljaard. Their email addresses can be found at the top of the page.

Yours faithfully,

Jay Chouhan
(Audiologist)

Appendix 19: Bedside and VNG assessment method and details

Bedside Assessment

The clinical bedside assessment sheet was designed by the researcher based on clinical tests included in established clinical assessments. The assessment consists of several tests which, together, provide valuable clinical information (Shepard, 2009; McCaslin, Dundas & Jaconson 2008; Fife et al., 2000). The tests that make up the bedside assessment are the following (McCaslin et al., 2008, Fife et al., 2000, Traccis et al., 2008, Teggi et al., 2008).

Otoscopy

Otoscopy was conducted with a Welsh Allen 3.5v diagnostic otoscope. Otoscopy allows for the observation of the status of the tympanic membrane and external auditory meatus (Martin & Clark, 2006).

Pure tone audiometry

A Grason Stadler GSI 61 audiometer was used to conduct audiometry. Manual pure tone audiometry was used to evaluate participants' peripheral hearing system using air and bone conduction (Carhart-Jerger, 1959; BSA, 2004).

The classification system by British Society of Audiology (2004) was used to describe and quantify the audiometric results of participants. Hearing loss was categorised into six categories; normal, mild, moderate, moderately-severe, severe and profound.

Tympanometry

Tympanometry was conducted using Grason Stadler TympStar. Tympanometry assesses the pressure of the middle ear space through the evaluation of the tympanic membrane as various amounts of pressure are applied in the ear canal (Martin & Clark, 2006). Tympanometry is essential in the bedside assessment as air filled middle ear spaces are needed for certain tests in the bedside assessment such as calorics. Fluid in the middle ear space may elicit similar symptoms to dizziness and this would affect test results (Golz, Westerman, Gilbert, Joachims & Netzer, 1991).

The classification system by BSA (2004) was used to categorize the tympanometry results of patients.

Nystagmus (spontaneous and gaze)

Nystagmus is the involuntary or unprovoked oscillatory movement of the eyes in either the horizontal or vertical planes (Martin & Clake, 2006; Gans & Yellin, 2007). Nystagmus may be the result of a variety of physiological and pathological conditions, one of which is vestibular stimulation or disease.

Spontaneous nystagmus is evaluated by observing the patients eyes with and without Frenzel lenses. The patient is instructed to keep their eyes open and to fixate on a target in the midline. The presence of spontaneous nystagmus may indicate pathologies in the central or peripheral vestibular system (McCaslin et al., 2008).

Gaze nystagmus is evaluated by instructing the patient is look at targets that are 30° from the midline, horizontally and vertically. The eyes are observed for true gaze nystagmus, and any changes in direction, intensity or type of spontaneous nystagmus.

The reliability of observation of spontaneous and gaze nystagmus may checked through three methods. The methods used to observe nystagmus includes direct observation, observation with the use of Frenzel's glasses and VNG. Direct observation has been found to have a sensitivity of 88.7% and specificity of 35.6%, observation with Frenzel's glasses has a sensitivity and specificity of 88.7% and 43.7% respectively (Guidetti, Monzani & Rovatti, 2006). VNG reliability is dependent on the equipment used (Gans & Yellin, 2007).

Smooth pursuit

Smooth pursuit is the ability of a person to visually follow a moving object without moving the head. The inability to smoothly follow a moving target may be suggestive of cerebella dysfunction, eye and neurological disorders, as well as CNS damage (McCaslin et al., 2009).

Smooth pursuit is assessed by instructing the patient to visually follow a target, without moving their head. The target is the clinician's index and thumb pressed together. The target is then moved in an arc of 60° with a speed of 40° per second. The eyes are observed for any saccades that may be present.

Clinical smooth pursuit testing is sensitive to age, drugs and can be affected by patient attentiveness (Shepard & Schubert, 2008).

Head thrust

The head thrust test evaluates the vestibulocular reflex (VOR) via a patient's ability to visually maintain fixation on a target during a quick horizontal movement of the head (Gans & Yellin 2007). The head thrust test assesses the integrity of the lateral semi-circular canals (SCC) (McCaslin et al., 2008).

The head is tilted 30° forward and the patient is instructed to keep looking at the clinician's nose. The head is then held under the ears on both sides and oscillated horizontally a few times, and then jerked without notice to one side and held. Eyes are observed for catch-up saccades and pupil movement (McCaslin et al., 2008).

A positive finding is the occurrence of catch-up saccade/s, when the head is jerked (Gans & Yellin, 2007). The head thrust test is usually used in conjunction with bi-thermal calorics as the head thrust test evaluates high frequency movements whilst the calorics evaluate low frequency movements (McCaslin et al., 2009). Vidal and Huijbregts (2005) reported the head thrust test to have a sensitivity of 71% and a specificity of 77% in identifying unilateral vestibular losses and a sensitivity of 84% and a specificity of 82% in identifying bilateral vestibular losses (Schubert, Tusa, Grine & Herman, 2004).

Head shake

The head shake test assesses the function of the vestibular VIII nerve that innervates the lateral SCC and the VOR. The head is tilted 30° forward and is shaken for 30 seconds horizontally.

The eyes are observed immediately after stopping for nystagmus with Frenzel's lenses (McCaslin et al., 2008).

A positive finding is the presence of nystagmus, post head shake and may be indicative of unilateral peripheral weakness of the vestibular system (McCaslin et al., 2008). The sensitivity of the head shake test increases with increased peripheral vestibular loss. The head shake test has been shown to have a sensitivity of 66% and a specificity of 77% when it is compared to the caloric test (McCaslin et al., 2008).

Hyperventilation test

Hyperventilation may cause feelings of impending faint, light-headedness, unsteadiness, giddiness and true vertigo (McCaslin et al., 2008). Hyperventilation is associated with anxiety-related disorders and as a result people who have diagnosed anxiety-related disorders may exhibit post hyperventilation nystagmus which may mask or give false negative results for vestibular dysfunction (McCaslin et al., 2008).The hyperventilation test assesses cerebellar dysfunction as well as the peripheral vestibular system (McCaslin et al., 2008).

The patient is instructed to breathe rapidly for a minimum of forty seconds and up to a minute, at a rate of one breath per second (McCaslin et al., 2008).. The patient is informed, to raise their hand when they feel dizzy and continue the deep breathing. A stop watch is used to time the duration. Frenzel lenses are used to observe the eyes as soon as the patient has reached 1 minute. Eye movements are observed for another minute, for nystagmus (McCaslin et al., 2008).

The presence of nystagmus results in a positive finding. Horizontal nystagmus is indicative of unilateral peripheral lesions. If the patient indicates that they are very dizzy before the end of the test, it is considered to be a "flag" for anxiety (McCaslin et al., 2008; Staab, 2008).

Cranial nerve function

Twelve cranial nerves are assessed in the bedside assessment, the test details are listed below:

I. *Olfactory nerve:* is responsible for the sensation of smell. The olfactory nerve is assessed by asking the patient if they are able to smell different odours or if they have difficulty in smelling. These questions provide information about the function of the olfactory nerve (Crossman & Neary, 2005).

II. *Optic nerve:* is assessed through the pupil reflex by shining a light on to the eye and then away; each eye is tested. A normal result is when the pupil contracts when the light is shone on it and dilates when the light is moved away (Larner, 2006).

III. *Occulomotor nerve:* is assessed through the pupil reflex, as mentioned above.

IV. *Trochlear nerve*: is associated with eye movements (Crossman & Neary, 2005). It is assessed through smooth pursuit, the pupil reflex and the saccades and nystagmus tests (mentioned above) (Larner, 2006).

V. *Trigeminal nerve:* is assessed by the corneal reflex. The corneal reflex is tested by touching the cornea lightly with a piece of cotton wool (Larner, 2006). Abnormal responses include not blinking, lack of sensation as well as jaw movements (Larner, 2006).

VI. *Abducens nerve:* is assessed by the same tests used to test the occulomotor nerve (Larner, 2006).

VII. *Facial nerve:* is assessed by the patient being asked to raise their eyebrows, close their eyes and keeping them closed against resistance, puffing out their cheeks and showing their teeth (Larner, 2006). Abnormal responses include inability to execute the exercises or partial completion of the exercises (Larner, 2006).

VIII. *Vestibulocochlear nerve:* is responsible for the sensation of hearing and balance (Crossman & Neary, 2005). The vestibular nerve is assessed by several of the tests in the bedside battery such as the head thrust, observation of nystagmus as well as the head shake test (Larner, 2006). The cochlear part of the VIII nerve is assessed through audiometry. The need to assess the vestibulo cochlear nerve is essential as the nerves that rise from the vestibular system and the cochlea run the same course to the brainstem. The function of the two parts of the nerve gives vital information in the formation of a differential diagnosis as well as identifying the relative site of lesion (Crossman & Neary, 2005).

IX. *Glossopharyngeal nerve:* the IX nerve is responsible for the sensation of taste. It is tested by asking the patient if they have any loss of tastes and if it occurs on one side of their tongue (Larner, 2006). Abnormal findings would be any report of loss in sensation of taste, which may indicate dysfunction of the nerve (Larner, 2006).

X. *Vagus:* innervates the pharynx and larynx (Crossman & Neary, 2005). The vagus nerve is tested by asking the patient if they experience any swallowing difficulties (dysphagia). With the possibility of the vagus nerve being affected, the brainstem may be the site of dysfunction and therefore, the assessment of the vagus nerve is important in the bedside assessment, as the brainstem an important part in the vestibular system (Crossman & Neary, 2005; Larner, 2006). In line with the audiologist's scope of practice, only questions are asked, and the gag reflex not tested.

XI. *Accessory nerve:* merges with the vagus nerves and controls the muscles of the jaw (Crossman & Neary, 2005). The movement of the jaw is essential in speech production. The patient is asked if they have difficulty producing words (dysarthria) (Larner, 2006). As the XI nerve runs through the brainstem, assessment provides valuable information about the brainstem function (Larner, 2006).

XII. *Hypoglossal nerve:* controls the muscles of the tongue (Crossman & Neary, 2005). If a patient has slurred speech or has difficulty in controlling their tongue and has difficulty producing speech, the hypoglossal nerve may be damaged (Larner, 2006). To test the hypoglossal nerve, the patient is asked to open their mouth, stick their tongue out, move the tongue left and right (Larner, 2006). Abnormal findings include deviation of the tongue to one side or difficulty to move the tongue (Larner, 2006).

Cerebellar tests

The cerebellar tests that are conducted are the heel-to shin, pronating and supinating, finger to nose tests. These tests assess the fine motor functions and thereby also test the cerebellum (Walker, 1990).

The heel-to-shin (leg dystaxia) test is administered by instructing the patient to use one of their heels to stroke their other leg's shin (Walker, 1990). The pronating and supinating (dysdiadokinesia) test is where the patient is instructed to place their hands, palm facing together. The patient is then instructed to keep their lower hand as is and turn the top hand over so that their palm is facing upwards, and to repeat so that the hand on top is returned to its initial position (Walker, 1990). This is repeated three times, for each hand being on top. The finger-to-nose test requires the patient to use their index finger to touch the tip of their nose. Each hand is used to touch the nose. The patient is then required to touch the clinician's finger and then their nose, with the clinician's finger changing positions randomly (Walker, 1990).

A positive finding is the inability of the patient to execute the three different tasks with ease. The reliability of these tests has not been reported according to Vidal & Huijbergst (2005). The

Dynamic Gait Index (DGI)

The DGI is a test that assesses gait, which predicts a risk of falling (Wrisley, Walker, Echternach & Strasnick, 2003). The test is comprised of 8 tasks, each of have a 4 point scale which describes how to score the patient performance. Tasks are administered from one to eight on an even surface (Chiu, Fritz, Light & Leozo, 2006). Tasks consist of gait with changing speed from normal-to-fast-to-slow, gait with moving of the head horizontally and vertically, pivot turning, stepping over a show box, gait whilst weaving between four small traffic cones and gait whilst stepping up and down a twenty step staircase (Chiu et al., 2006).

Each item has descriptors of functional performance to permit scoring on a scale of 0 (worst) to 3 (best performance). The scores from each of the tasks are tallied at the end of the test. A score out of 24 is calculated. A score of 21 or above indicates a minimal risk of falling and a score of 19 or below indicates an increased risk of falling (Shumway-Cook, Baldwin, Polissar & Gruber, 1997. Although the DGI is not specifically a vestibular test, it has the ability to discriminate between patients who complain of vestibular dysfunction and report falls, and those who do not reports falls (Wrisley et al., 2003).

The DGI has a sensitivity and specificity of 59% and 64% respectively (Shumway-Cook et al., 1997). DGI has been researched regarding its inter-rate and intra-rate reliability (McConvey, Bennett, 2005; Whitney, Marchetti, Schade & Wrisley, 2004; Chiu et al., 2006). The inter-rater reliability and intra-rater reliabilities have been documented to be in the 90th percentile of ratings. McConvey & Bennett (2005) reported an inter-rater reliability of 0.983 and an intra-rater reliability of 0.986. The high reliability scores suggested good inter and intra-rate reliability with the DGI.

Romberg (standard and sharpened)

The Romberg test is one that assesses dorsal column function (Gokula, 2003). There are two types of the Romberg tests, the standard and the sharpened. The standard Romberg is when the patient is standing with their feet together and their hands crossed over their shoulders. The sharpened Romberg is when the patient stands with their feet positioned heel-to-toe (Gokula, 2003). The two positions are conducted on the floor with the patient's shoes off. The patient first does each position with their eyes open followed with their eyes closed, for 30 seconds each (Gokula, 2003).

Criteria for a positive Romberg is, if the patient moves from their initial position either by moving their feet or hands and opening their eyes in an "eyes closed" condition (Gokula, 2003). Additionally, the patient may sway from the initial position; a significant sway from the midline is considered an abnormal finding but does not exclude psychological involvement (Gokula, 2003). A negative Romberg test is found when the patient is able to maintain the position for 30 seconds (Gokula, 2003).

The sharpened Romberg test was shown to have a reliability of 0.85 and a test-retest reliability of 0.66 according to Yardley, Beech, Zander, Evans and Weinman, (1998).

Modified Clinical Test of Sensory Organisation and Balance (mCTSIB)

The mCTSIB is designed to evaluate a patient's reliance on their visual, vestibular and proprioceptive sensors in order to maintain posture (McCaslin et al., 2009). There are four conditions in the mCTSIB (Hart-Hughes, 2004); 1. The patient stands on a firm surface with their hands place across their chest onto their shoulders, with their eyes open, 2. The patient stands on a firm surface as in 1 with their eyes closed, 3. The patient stands on a foam block with their hands across their chest onto their shoulders, with their eyes open, 4. The patient stands on the foam block as in 3 with their eyes closed (Hart-Hughes, 2004). Each condition is conducted for 30 seconds (Hart-Hughes, 2004).

A positive test is indicated if the patient steps from their initial position, opens their eyes in an eyes-closed condition or requires assistance to prevent a fall (Hart-Hughes, 2004). A negative result is indicated by the patient being able to hold their position for the full 30 seconds (Hart-Hughes, 2004). Scoring is done by giving the patient a point for every second that they are able to maintain their position in each condition. The points are then added up and a mean score is calculated for the test (Hart-Hughes, 2004).

The test performance of the CTSIB has been shown to have good test-retest reliability of 0.75 in older adults and 0.99 in young adults, as well as an inter-rater reliability of 0.99 (McCaslin et al., 2009). The reliability of the CTSIB is high and therefore minimal threats to reliability were present.

Dix Hallpike Manoeuvre

The Dix Hallpike is used to identify benign paroxysmal positional vertigo (BPPV) (Viire, Purcell & Baloh, 2005). The patient is seated upright on a bed with their legs either straightened or slightly bent. The patient is positioned to ensure that upon lying down their head will be

unsupported. To begin, the head is turned 45° to one side and the clinician rapidly moves the patient from an upright seated position to a dropped position with the patient's head hanging slightly at the 45° angle, for twenty seconds (Viire et al., 2005). The patient is then lifted to the initial position with the angle of the head maintained.

A positive test is characterised by various patterns of nystagmus depending on the type and SCC affected by the BPPV, and may be accompanied with nausea and possible vomiting (Barrin, 2009). The test is conducted bilaterally.

The Dix-Hallpike manoeuvre is considered to be the gold standard in the diagnosis of BPPV (Bhattacharyya et al., 2008). Lopez-Escamez et al. (2000) reported that the Dix-Hallpike manoeuvre had a sensitivity of 82% and a specificity of 71%. Hanley & O'Dowd (2002) found that the Dix-Hallpike manoeuvre had a positive predictive value of 83% and a negative predictive value of 52%.

Appendix 20: Clock Drawing Test

Palmer & Meldon (1998).

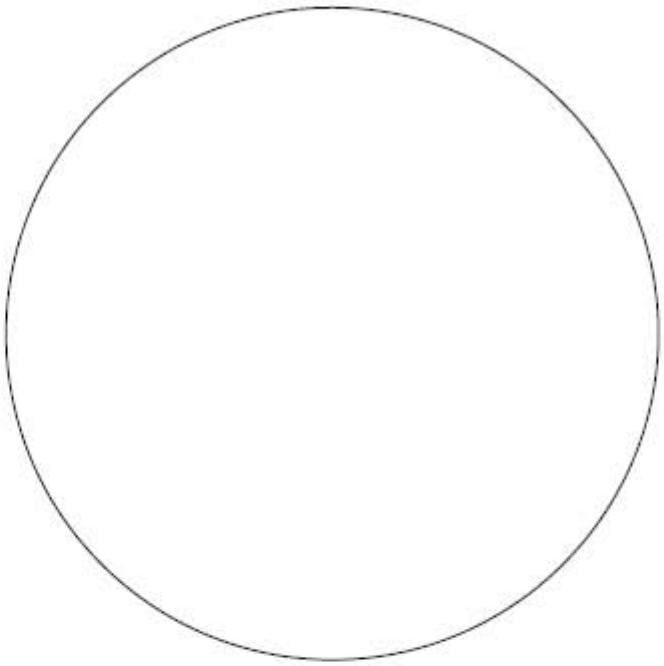
CLOCK DRAW TEST

Participant ID:_____

Date:____/____/_____

1) Inside the circle, please draw the hours of a clock as they normally appear

2) Place the hands of the clock to represent the time: "ten minutes after eleven o'clock"



Appendix 21: Dynamic Gait Index

Dynamic Gait Index

Description: Developed to assess the likelihood of falling in older adults. Designed to test eight facets of gait.
Equipment needed: Box (Shoebox), Cones (2), Stairs, 20' walkway, 15" wide
Completion: Time:15 minutes **Scoring:** A four-point ordinal scale, ranging from 0-3. "0" indicates the lowest level of function and "3" the highest level of function. Total Score = 24
Interpretation: ≤ 19/24 = predictive of falls in the elderly > 22/24 = safe ambulators

1. Gait level surface _____

Instructions: Walk at your normal speed from here to the next mark (20') *Grading:* Mark the lowest category that applies.

(3) Normal: Walks 20', no assistive devices, good sped, no evidence for imbalance, normal gait pattern
(2) Mild Impairment: Walks 20', uses assistive devices, slower speed, mild gait deviations.
(1) Moderate Impairment: Walks 20', slow speed, abnormal gait pattern, evidence for imbalance.
(0) Severe Impairment: Cannot walk 20' without assistance, severe gait deviations or imbalance.

2. Change in gait speed _____

Instructions: Begin walking at your normal pace (for 5'), when I tell you "go," walk as fast as you can (for 5'). When I tell you "slow," walk as slowly as you can (for 5'). *Grading:* Mark the lowest category that applies.

(3) Normal: Able to smoothly change walking speed without loss of balance or gait deviation. Shows a significant difference in walking speeds between normal, fast and slow speeds.
(2) Mild Impairment: Is able to change speed but demonstrates mild gait deviations, or not gait deviations but unable to achieve a significant change in velocity, or uses an assistive device.
(1) Moderate Impairment: Makes only minor adjustments to walking speed, or accomplishes a change in speed with significant gait deviations, or changes speed but has significant gait deviations, or changes speed but loses balance but is able to recover and continue walking.
(0) Severe Impairment: Cannot change speeds, or loses balance and has to reach for wall or be caught.

3. Gait with horizontal head turns _____

Instructions: Begin walking at your normal pace. When I tell you to "look right," keep walking straight, but turn your head to the right. Keep looking to the right until I tell you, "look left," then keep walking straight and turn your head to the left. Keep your head to the left until I tell you "look straight," then keep walking straight, but return your head to the center. *Grading:* Mark the lowest category that applies.

(3) Normal: Performs head turns smoothly with no change in gait.
(2) Mild Impairment: Performs head turns smoothly with slight change in gait velocity, i.e., minor disruption to smooth gait path or uses walking aid.
(1) Moderate Impairment: Performs head turns with moderate change in gait velocity, slows down, staggers but recovers, can continue to walk.
(0) Severe Impairment: Performs task with severe disruption of gait, i.e., staggers outside 15" path, loses balance, stops, reaches for wall.

4. Gait with vertical head turns _____

Instructions: Begin walking at your normal pace. When I tell you to "look up," keep walking straight, but tip your head up. Keep looking up until I tell you, "look down," then keep walking straight and tip your head down. Keep your head down until I tell you "look straight," then keep walking straight, but return your head to the center. *Grading:* Mark the lowest category that applies.

(3) Normal: Performs head turns smoothly with no change in gait.

(2) Mild Impairment: Performs head turns smoothly with slight change in gait velocity, i.e., minor disruption to smooth gait path or uses walking aid.

(1) Moderate Impairment: Performs head turns with moderate change in gait velocity, slows down, staggers but recovers, can continue to walk.

(0) Severe Impairment: Performs task with severe disruption of gait, i.e., staggers outside 15" path, loses balance, stops, reaches for wall.

5. Gait and pivot turn _____

Instructions: Begin walking at your normal pace. When I tell you, "turn and stop," turn as quickly as you can to face the opposite direction and stop. *Grading:* Mark the lowest category that applies.

(3) Normal: Pivot turns safely within 3 seconds and stops quickly with no loss of balance.

(2) Mild Impairment: Pivot turns safely in > 3 seconds and stops with no loss of balance.

(1) Moderate Impairment: Turns slowly, requires verbal cueing, requires several small steps to catch balance following turn and stop.

(0) Severe Impairment: Cannot turn safely, requires assistance to turn and stop.

6. Step over obstacle ____

Instructions: Begin walking at your normal speed. When you come to the shoebox, step over it, not around it, and keep walking. *Grading:* Mark the lowest category that applies.

(3) Normal: Is able to step over the box without changing gait speed, no evidence of imbalance.

(2) Mild Impairment: Is able to step over box, but must slow down and adjust steps to clear box safely.

(1) Moderate Impairment: Is able to step over box but must stop, then step over. May require verbal cueing.

(0) Severe Impairment: Cannot perform without assistance.

7. Step around obstacles _____

Instructions: Begin walking at normal speed. When you come to the first cone (about 6' away), walk around the right side of it. When you come to the second cone (6' past first cone), walk around it to the left. *Grading:* Mark the lowest category that applies.

(3) Normal: Is able to walk around cones safely without changing gait speed; no evidence of imbalance.

(2) Mild Impairment: Is able to step around both cones, but must slow down and adjust steps to clear cones.

(1) Moderate Impairment: Is able to clear cones but must significantly slow, speed to accomplish task, or requires verbal cueing.

(0) Severe Impairment: Unable to clear cones, walks into one or both cones, or requires physical assistance.

8. Steps _____

Instructions: Walk up these stairs as you would at home, i.e., using the railing if necessary. At the top, turn around and walk down. *Grading:* Mark the lowest category that applies.

(3) Normal: Alternating feet, no rail.

(2) Mild Impairment: Alternating feet, must use rail.

(1) Moderate Impairment: Two feet to a stair, must use rail.

(0) Severe Impairment: Cannot do safely.

TOTAL SCORE: ___ / 24

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Shumway-Cook A, Woollacott M. *Motor Control Theory and Applications*, Williams and Wilkins Baltimore, 1995: 323-324