Research Urodynamics:

Developing a Greater Understanding of Lower Urinary Tract Dysfunction and the Interrelated Role of the Nurse Researcher

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Finally, this thesis is dedicated to the memory of Louis – the ultimate cat, expert rummager and desk disorganiser, and my study buddy (2004–2018). Your distraction techniques were legendary; your paw prints are forever on my heart.

Statement confirming that this work has not been submitted for another academic award

I can confirm that none of the selected publications for the award of Doctor of Philosophy (DPhil) have been submitted for another academic award either in this or any other institution.

Statement of Authorship

This thesis is based on the following collection of works (Table 1), published between 2004 and 2017. The papers, and one book chapter, are a reflection of my research journey and scholarly contribution to original research; these relate to the role of research urodynamics in the assessment of lower urinary tract function, and the interrelated role of the urology nurse in translating research evidence into theory, education and clinical practice.

DPhil Objectives

In summary, this critical commentary will:

1) Illustrate a meaningful journey of academic enquiry, which shows how advanced scholarship has been achieved in the field of urodynamic practice through a body of peer reviewed published work of national and international standing.
2) This work will also demonstrate how pre-existing knowledge and opinion was investigated, and to what extent this research process generated new knowledge that latterly shaped current urological management, opinion, and guidelines for patients with lower urinary tract dysfunction.
3) Demonstrate the associated knowledge and critical understanding of urodynamic practice, the relationship, significance, and role of research urodynamics; this includes the related methodological enquiry that supports the portfolio of published work.
4) Reflect on how this enquiry has shaped my continuing professional development, knowledge, understanding, and clinical expertise within a highly specialised field of academic research and urodynamic practice.

Portfolio of Published Work: Overview of DPhil Commentary

The purpose of this doctoral submission, through a collection of published work, is to present a personal journey of academic enquiry and engagement in developing and conducting high quality research. The collection includes ten published papers, which predominantly involve quantitative and mixed methods, and one book chapter. These research outputs will demonstrate how I have advanced urodynamic practice, as well as my critical understanding of current knowledge in this highly specialist field.

Table 1: Outline of Published Work in Chronological Order

Portfolio of Published Work	Declaration of Authorship
1. Thomas, A., Cannon, A., Bartlett, E., Ellis-Jones, J. and Abrams, P. (2004) The natural history of lower urinary tract dysfunction in men: the influence of detrusor underactivity on the outcome after transurethral resection of the prostate with a minimum 10-year urodynamic follow-up. *BJU International.* 92 (6), pp.745–50	Co-author: Setting up the research clinics, collecting and recording urodynamic investigations/data collector, analysis and interpretation of data, electronic capture and storage of data. Draft review. (Quantitative Methods)
2. Thomas, A., Cannon, A., Bartlett, E., Ellis-Jones, J. and Abrams, P. (2005) The natural history of lower urinary tract dysfunction in men: minimum 10-year urodynamic follow-up of transurethral resection of prostate for bladder outlet obstruction. *Journal of Urology.* 174 (5), pp.1887–91	Co-author: Setting up the research clinics, collecting and recording urodynamic investigations/data collector, analysis and interpretation of data, electronic capture and storage of data. Draft review. (Quantitative Methods)
3. Thomas, A., Cannon, A., Bartlett, E., Ellis-Jones, J. and Abrams, P. (2005) The natural history of lower urinary tract dysfunction in men: minimum 10-year urodynamic follow-up of untreated detrusor underactivity. *BJU international.* 96 (9), pp.1295–300	Co-author: Setting up the research clinics, collecting and recording urodynamic investigations/data collector, analysis and interpretation of data, electronic capture and storage of data. Draft review. (Quantitative Methods)
4. Thomas, A., Cannon, A., Bartlett, E., Ellis-Jones, J. and Abrams, P. (2005) The natural history of lower urinary tract dysfunction in men: minimum 10-year urodynamic follow-up of untreated bladder outlet obstruction. BJU *international.* 96 (9), pp.1301–6	Co-author: Setting up the research clinics, collecting and recording urodynamic investigations/data collector, analysis and interpretation of data, electronic capture and storage of data. Draft review. (Quantitative Methods)
5. Hashim, H., Ellis-Jones, J., Swithinbank, L., Woodward, M., Small, D., Frank, J. and Abrams, P. (2005) Trying to predict 'dangerous' bladders in children: The area under the curve concept. *Journal of Paediatric Urology.* 1 (5), pp.343–347	Co-author: I was approached by Hashim to undertake a retrospective review, and interpretation, of paediatric urodynamic investigations. Draft review. (Quantitative Methods)
6. Ellis-Jones, J., Swithinbank, L., and Abrams, P. (2006) The impact of formal education and training on urodynamic practice in the UK: A survey. *Neurourology Urodynamics.* 25 (5), pp.406–410	Lead author: I conceived, designed, and conducted this study. Paul Abrams undertook draft paper review, as this was my first published paper as lead author. (Quantitative Methods)

Portfolio of Published Work	Declaration of Authorship
7. Garnett, S., Swithinbank, L., Ellis-Jones, J. and Abrams, P. (2009) The long-term natural history of overactive bladder symptoms due to idiopathic detrusor overactivity in women. *BJU International.* 104 (7), pp.948–953	Co-author: Contacting research participants, informed consent process. Setting up the research clinics, collecting and recording urodynamic investigations, data collector – analysis and interpretation of data, electronic capture and storage of data. Draft review. (Quantitative Methods)
8. Robinson, D., Abrams, P., Cardozo, L., Ellis-Jones, J., Heath, P. and Wyllie, M. (2011) The efficacy and safety of PSD503 (phenylephrine 20%, w/w) for topical application in women with stress urinary incontinence. A phase II, multicentre, double blind, placebo controlled, 2-way cross over study. *European Journal of Obstetrics, Gynaecology, and Reproductive Biology.* 159 (2), pp.457–460	Co-author: Informed consent process, and consenting participants. Setting up the research clinics, collecting and recording urodynamic investigations, data collector – analysis and interpretation of data, electronic capture and storage of data. Draft review. (Quantitative Methods)
9. **Ellis-Jones, J., Swithinbank, L. and Abrams, P. (2013)** The Bridges and Barriers to 'good' Urodynamic Practice: a regional perspective. *International Journal of Urological Nursing.* 7 (1), pp.3–8	Lead author: I conceived, designed, conducted and analysed this study. Paul Abrams undertook draft paper review. (Mixed Methods)
10. Gammie, A., Abrams, P., Bevan, W., Ellis-Jones, J., Gray, J., Hassine, A., Williams, J. and Hashim, H. (2015) Simultaneous in vivo comparison of water-filled and air-filled pressure measurement catheters: Implications for good urodynamic practice. *Neurourology and Urodynamics.* 35 (2), pp.1–8	Co-author: Informed consent process, and consenting participants. Setting up the research clinics, collecting and recording urodynamic investigations/data collector, analysis and interpretation of data, electronic capture and storage of data. Draft review. (Quantitative Methods)
11. Ellis-Jones, J. and Hashim, H. (2017) Urodynamics. In: Hamdy, F., Eardley, I., ed., (2017) *Oxford Textbook of Urological Surgery*. Oxford: Oxford University Press, pp.230–244	Co-author with Hashim, we were approached by OUP and asked to write a chapter on Urodynamics for this reference textbook on urological surgery.

Five of the ten papers **(Papers 1–4, and 7)** focus on the "natural history" of lower urinary tract dysfunction. The aim of four of the studies (**Papers 1–4)** was to follow-up men who had previously been seen in the urology department who had presented with lower urinary tract symptoms (LUTS), and repeat their urodynamic investigations at least ten years following their initial consultation when they had received urodynamic diagnosis of bladder outlet obstruction (BOO) or detrusor underactivity (DUA). These patients were sub-categorised into four groups: 1) Outcome of surgery (transurethral resection of prostate [TURP]) with co-existing detrusor underactivity, 2) Outcome of untreated bladder outlet obstruction, 3) Outcome of untreated detrusor underactivity, 4) Outcome of untreated bladder outlet obstruction. The fifth natural history paper, following on from the previous natural history studies, was to review women who had been given the urodynamic diagnosis of detrusor overactivity (DO) at least 10 years previously. At the time this research was undertaken little was known about the long term outcomes of

BOO in men or DO in women, and associated treatment benefits/options. The long term storage of patient urodynamic investigation records enabled the use of a longitudinal research design, which was adopted in all five studies with retrospective review of existing records, followed by prospective collection of data and review of the same clinical investigation with which to draw a comparison at least 10 years later.

The purpose of these studies was to gain new knowledge and a deeper understanding of the natural progression of benign urological conditions such as BOO, DUA and DO due to the long term effects of living with one of them, or a combination of BOO and DUA; BOO, DUA and DO; or DO, or DO and DUA. By nature these can be complex in themselves, and become more difficult to manage or treat when they are found in combination through urodynamic assessment. The results of these investigations can therefore help the health care professional (HCP) make informed decisions about the most appropriate treatment options to inform patient choice. The primary aim of research urodynamics (UDS), within this context, was to capture and reproduce the individual patients' current symptoms in an objective manner – providing baseline measurements which were reproducible under prospective research study conditions. My objective is to provide a critical analysis and narrative that links my understanding of the methodology of this enquiry, with my contribution to the research as a clinical research nurse. Correspondingly, there will be emphasis on how the impact of this research evidence has influenced current practice and guidelines for HCPs.

Paper 5 provides a retrospective review and re-analysis of paediatric urodynamic investigations to explore the concept of the 'area under the curve' to determine whether this could be used in the future to predict dangerous or 'high pressure' bladders in children who could potentially be at risk of associated renal damage. The aim of **paper 6** (postal survey) and **paper 9** (postal survey and telephone interviews), which I conceived, designed and conducted, was to investigate the impact of urodynamic education and training on current practice in the United Kingdom (UK). These studies included participants who had completed a urodynamic educational course, which at the time was the only accredited certificate course in the UK (Bristol Urological Institute, 2018).

Paper 8 demonstrates my contribution to a clinical trial, which was a randomised, double-blind, cross-over study and investigated the safety and efficacy of a novel gel application

to the urethral sphincter. The last paper (**paper 10**) used a comparative study method approach to evaluate the two different types of urodynamic catheters – the existing water-filled, versus the new design, the air-charged catheter, which had been awarded a CE mark as an approved medical device in the European Union (EU). The book chapter (**11**) is my most recent published work, and provides an overview of urodynamics within the Oxford Textbook of Urological Surgery. This was work that was undertaken by invitation, based on my existing research outputs and professional contribution to urodynamics – and as this synopsis reveals, they became inextricably linked.

Introduction

The background to my development as a nurse researcher

In addition to the above overview, this portfolio of published work should be considered within the context of my research journey, which started when I was a research nurse at the Bristol Urological Institute (BUI) in 1997. The responsibilities within this role were varied; over time I became accountable for data collection and storage, and this was where my knowledge and understanding of research design and related methodology became established. Primarily, I was involved in longitudinal research studies, which has given me a lasting impression and appreciation of research in clinical practice. Within this setting, I also gained an in-depth understanding of the significance of ensuring that urodynamic test data were both reliable and valid in their measurement. From this experience, and associated learning, I began to appreciate the significance of ensuring objectivity and rigour throughout the aforementioned studies.

During this time as a research nurse my learning was also enhanced through parallel involvement in commercially sponsored research for pharmaceutical companies (new medical therapies) and surgical trials (male and female urology), where both quantitative and qualitative research methods were frequently used. My training in good clinical practice (GCP) was particularly useful as it provided me with a solid framework for conducting ethical research (DoH, 2005, 2008; National Institute for Health Research, 2018). This enabled me to protect the rights, interests, wellbeing and safety of research participants, and understand the overriding importance of the informed consent process. As my role, research knowledge and skills developed, I became responsible for the set-up, co-ordination, and management of clinical research trials and projects in the BUI, working closely with the North Bristol Trust (NBT) Research, Development and Innovation team.

Subsequently, this led to the development of new professional working partnerships for me, and the ability to work as an independent research nurse ‘expert’ in an advisory capacity to external companies such as Ono Pharma, Pfizer, Astellas, Plethora Solutions, and ConvaTec/Wellspect Healthcare. Latterly, this additional and unique experience gave me the confidence to develop my own ideas and the ability to conduct independent research.

The research setting: The Bristol Urological Institute

The BUI is at the heart of my research, so it is important to provide some background to its scope and influence on researchers, patients and current practice. Founded in 1993 as a charity, and based at Southmead Hospital in Bristol, it became part of North Bristol National Health Service (NHS) Trust in 2010. The BUI is now one of the largest urology departments in the South West region of the NHS, and also one of the largest departments in the country. It is world-renowned for 'state of the art' urology and high quality urology research outputs, providing surgical training, educational initiatives, and pioneering urodynamics. The BUI has supported many research fellows studying for their Medical Doctorates (MDs), and research nurses in gaining higher nursing degrees (MSc). This was my first experience of truly exceptional leadership within the National Health Service (NHS), which has strongly influenced my professional development as a nurse researcher. As part of my researcher role I attended regular department 'Away Days', led by Professor Paul Abrams; this forum was where we met as a part of the wider research team. I presented my research and progress reports (twice yearly), discussed current research projects, and contributed my ideas for future research.

It is also important to note, that at the time of this research the BUI held a large database in the department, containing the majority of the urodynamic records of patients who had undergone NHS urodynamic investigations. These have been securely stored/archived within the department since 1972, providing a relatively unrivalled natural resource of valuable data. This database has been rigorously maintained alphabetically and dissected by gender (adults – male/female), in addition to a paediatric section. The BUI was therefore well placed to conduct numerous research studies using this resource, in addition to identifying future research questions. Initially, I did not appreciate the value of such a rich and accessible database, which would later develop current European Association of Urology (EAU) practice guidelines (EAU, 2015b), for the assessment of men with lower urinary tract symptoms (LUTS). Within this portfolio of publications the database was used extensively to help identify participants **(Papers 1–4, 5 and 7)**, for the retrospective analysis of hospital notes and urodynamic records. This body of work has since provided a significant contribution to the field of urology and urodynamics.

The nature and context of urodynamics in relation to lower urinary tract dysfunction

It is also important to state the nature and context of 'Urodynamics', which is the broader term often given to the collection of investigations that patients undergo as part of an assessment of the lower urinary tract (Abrams, 2006). This includes uroflowmetry, urethral pressure profiles, filling and voiding cystometry and pressure-flow studies. It is a long established investigational procedure for patients with LUTS, which is highly invasive by nature, and involves catheterisation of the urethra and rectum; the procedure also demands a high level of technical skill and clinical expertise (United Kingdom Continence Society (UKCS), 2009). Bothersome urinary symptoms are common among the adult population, with some symptoms originating in childhood. It is estimated that there are around 14 million people living in the UK with some form of bladder problem and manifestations of urinary symptoms (Bladder and Bowel Foundation, 2016). In women, symptoms may vary from frequency of micturition, with related urinary urgency or urinary urgency incontinence, to stress urinary incontinence or a combination of symptoms, which may be classified as mixed urinary incontinence (EAU, 2015a). These symptoms can also affect men, and commonly occur with voiding symptoms such as hesitancy, poor urinary flow, nocturia and incomplete bladder emptying (EAU, 2015b). LUTS, in both men and women, often have an undesired effect on their related emotional and physical well-being (Avery *et al*. 2013). Although these symptoms are not life-threatening, they can constitute a significant impact on overall quality of life due to change in mood, sleep deprivation, embarrassment, lifestyle limitations and social isolation/stigma (Abrams, Smith and Cotterill, 2014).

Patients usually present themselves to their general practitioner (GP) with one or more urinary symptoms and at this initial stage they are usually managed in primary care, or referred to a continence advisor or nurse for further assessment. However, if the symptom(s) has/have not been managed or resolved successfully in the community, they are usually referred to a specialist Health Care Professional (HCP) e.g. doctor/nurse, for assessment – most often to urology, gynaecology, or urogynaecology outpatient departments. This further assessment may then lead to a urodynamic referral for further investigation (EAU Guidelines, 2015a, 2015b). Prior to this level of invasive investigation, there is usually the 'urodynamic question' in mind (Schäfer *et al.* 2002), which in turn

provides the clinical rationale for requesting urodynamics. If this overarching question does not exist, the HCP should in theory question this and be cautious about proceeding with the investigation, which also requires informed consent from the patient. The result of these clinical investigations (the urodynamic diagnosis) often provides the platform for the clinical decision making process (National Institute for Health and Care Excellence (NICE), 2013), and this ultimately guides individual health care professionals in their treatment and management planning choices. However, despite this guidance, the clinical assessment and interpretation of urodynamic investigations can be variable depending on the level of knowledge and experience of the individual practitioner (UKCS, 2009). Potentially, this can have a negative impact on the patient, where a poorly interpreted urodynamic investigation could provide unreliable data, in turn affecting adversely the success or outcome of a proposed treatment or management plan (Thorpe, 2010).

Historically, urodynamics have also played an important role in clinical trials as they provide routine baseline assessments of the lower urinary tract for novel conservative, medical and surgical therapies (Tammela *et al.* 1999). These data give objective evidence and confirmation of presenting urinary symptoms (Shah, 2011), as well as evaluating the safety and effectiveness of treatment (Yamanishi *et al*. 2011). Within clinical trials, it is vitally important to adhere to the inclusion and exclusion criteria of clinical trial protocols, where patients must have clear and accurate documented evidence of 'urodynamic diagnosis' prior to randomisation/inclusion (Lewis and Abrams, 2000). Whilst I could appreciate their role in research, I was also aware that urodynamics had undergone peer review within the last two decades to assess their clinical value.

The National Institute for Health and Care Excellence (NICE) clinical guideline group (Jones, Hill and Chapple, 2010), could not identify sufficient evidence to recommend the routine use of urodynamic investigation in men with lower urinary tract symptoms (LUTS). However, there is evidence to support the role of urodynamics in the decision making process and related management of urinary incontinence (Clement *et al.* 2013; Clement *et al*. 2015). This is still a highly contentious area, and the use of NICE (2013) guidelines has been challenged by experts within this field, as urodynamics are often seen as a valuable test to help rule in/rule out differential diagnoses and guide further management, treatment and care (Hilton *et al*. 2012). During this time, urodynamic

practice has been governed by the United Kingdom Continence Society (UKCS) national standards (UKCS, 2009), and the widely accepted International Continence Committee (ICS) standardised frameworks for urodynamic practice (Schäfer *et al*. 2002) – recently revised by the ICS standardisation steering committee (Rosier *et al.* 2017).

Whilst it has been accepted that there are still some gaps in the available evidence, it should be acknowledged that the ongoing debate can potentially create uncertainties in the clinical decision making process (Buckley *et al*. 2010). To address this, more recent studies have been designed to assess whether urodynamics should become part of the diagnostic pathway for male and female patients. A report on the feasibility of conducting definitive randomised controlled trials of urodynamic studies in women who require assessment for stress urinary incontinence surgery was proposed (Hilton *et al* 2015). Similarly, a UK-based study UPSTREAM (Urodynamics for Prostate Surgery Trial; Randomised Evaluation of Methods) has been undertaken to evaluate further the role of urodynamics and associated clinical outcomes (Bailey *et al*. 2015), as part of the clinical management/diagnostic pathway for the men with BOO. These publications and continuing professional debate highlight the need for good urodynamic research evidence (Jiang and Kuo, 2017). This existing body of evidence highlights the scope and significance of UDS in the assessment of LUTD, and 'sets the scene' for the following critical commentary.

Individual contribution to the selected papers, methods, and emerging themes

The next section provides a critical analysis of my original contribution to the research submitted in the portfolio of published work (Table 1). This narrative will discuss this research within the wider context of contemporaneous urological research and related clinical practice. Henceforth, the aim is to link the papers, not only in their chronological order but also as they illustrate my personal development as a researcher. All the papers are empirical in nature and were co-authored; I include testimonials supporting my original contribution to each study (Appendix One). Three main themes emerge through this analysis, which converts my portfolio of publications into an integrated body of work:

i) Research urodynamics – The early years: becoming a nurse researcher

ii) Nursing leadership in urodynamic research and clinical trials

iii) Advancing urodynamic practice – translating research into practice

A deeper personal reflection on the methods used, underpinning research philosophy and the impact of this work, will be presented in a subsequent section (p.35).

Research urodynamics: The early years – becoming a nurse researcher

The importance of the research/study design became apparent early on in my career as a urology nurse researcher. I had already gained some research experience from my time working in critical care environments where I had been a member of the nursing research interest group. This work mostly involved literature reviews, which were linked to clinical practice issues in the intensive care setting. These activities piqued my interest in research (and later led to me applying for a research post in the BUI), and provided me with a basic understanding of the principles of research and evidence based practice. The research process is pivotal to the set-up, conduct and the success of each study in meeting their research aims and objectives (Polit and Beck, 2017). As part of my induction into the BUI research team, I familiarised myself with the research design and data collection methods of the studies with which I was involved, so understanding this concept was a key learning point. This formative experience was integral to my role and

taught me how to appreciate where each research idea or question begins, and which methods to use within the research design so that those chosen are appropriate (and able) to answer the research question (Parahoo, 2014).

Initially, I was exposed to quantitative research design **(Papers 1–4)**, which used non-experimental longitudinal research methods. Longitudinal research can be more expensive to conduct in terms of time and resources (Caruana *et al.* 2015). However, it is a useful way to gather data about a group (cohort) at two separate points in time (Parahoo, 2014), thus enabling comparisons to be drawn between them and this approach is classified as non-experimental (or observational) research (Polit and Beck, 2017). This method is beneficial in determining the natural history of a medical condition or complaint (Bowling, 2014), as well as the management or treatment interventions outcomes, so supporting correlational analysis (Ross, 2012). It can be argued that one of the difficulties in conducting a retrospective analysis of data is that information can be missing or mislaid, making data difficult to interpret and excluding potential participants from taking part in the study (Caruana *et al.* 2015; Polit and Beck, 2017). Nevertheless, this approach allowed us to study large groups of men to help gain a deeper understanding of the natural history of lower urinary dysfunction, and its relationship with treated or untreated LUTS. Similarly, despite some of these limitations, this method is particularly valued in predicting treatment outcomes in healthcare (Ross, 2012), where the published evidence can further support clinical decision-making in day-to-day practice, as well as informing patient treatment options.

Prior to this research the only published work available was based on short-term urodynamic follow-up (mean 11 months) in men post elective prostatectomy (Neal *et al.* 1989). The long-term follow-up series made a significant original contribution to the relatively limited evidence base on the efficacy of TURP in men with BOO and DUA, and equally important, a much greater understanding of the long-term outcomes of men with untreated BOO and DUA. These seminal studies subsequently led to further BOO and DUA research in the following years, which are discussed in the research impact and knowledge mobilisation section (Table 4). In **papers 1–4** the data collection points were pre-1986, as the male participants were seen at least 10 years previously for investigation of their lower urinary tract dysfunction, and 1996 when the study started. Similarly, the

urodynamic database search for **Paper 7** reviewed patient records from 1990/91, repeating the UDS investigations in women with idiopathic DO/DOI 10 years later. This was when I became aware of the role and value of patient databases in health outcomes research, where they can be particularly useful providing observational data in large patient cohorts that would otherwise be difficult to study (Dreyer *et al.* 2010). Consequently, I was able to appreciate that observational research can be applied to virtually any healthcare setting to gain useful insight into current practice and areas of concern, either retrospectively or prospectively.

Papers 1–4 were all based on research proposals that had received full ethical approval; my urodynamic training was based on the Certificate in Urodynamic Courses that started in 1995 (Bristol Urological Institute, 2018), using current terminology and techniques (Abrams, Feneley, and Torrens, 1983; Mundy, Stephenson and Wein, 1994; Griffiths *et al.* 1997). At this time point, urodynamic techniques were also being scrutinised by leading specialists in the field. The aforementioned studies (and their design) were greatly influenced by colleagues within the department, who were themselves devising urodynamic protocols for developing quality control procedures in clinical trials/research (Lewis and Abrams, 2000). This relationship was significant in my development as a researcher, as I later became the successor to Lewis when she retired, taking over her responsibility for education and training for new research (and clinical) staff in 2000. This timely experience highlighted the importance of data quality initiatives, and the importance of scientific rigour in clinical research, further enhancing my understanding of the research process. This leading development in quality control procedures preceded the on-going work of the ICS committee for urodynamics, who at the time of this research were working towards the seminal work and preliminary standardisation of 'Good Urodynamic Practice' (Schäfer *et al*. 2002). This meant that I was fortunate enough to be trained in my investigational measurement and data collection techniques by two of the world-leading experts in urodynamics.

As a researcher, I was enrolled into the BUI training courses so that I could learn the theory, practice and interpretation of urodynamic investigations in adults and children. This was an important part of my basic training in urodynamics, which subsequently engaged me with the research aspect of urodynamics on a much deeper level. Many of

the clinical trials that I worked on required research participants to undergo full urodynamic assessment prior to treatment; this often featured as part of the study protocol inclusion/exclusion criteria. At this time I was also conducting urodynamics for the multi-centre randomised surgical trial of Tension-Free Vaginal Tape (TVT) and Colposuspension, in women with stress incontinence (Ward and Hilton, 2002), which adhered to strict urodynamic protocols pre- and post-operatively. This meant that I was responsible for completing clinical report forms, where urodynamic data had to be interpreted and recorded accurately, where consistency in urodynamic techniques was essential. Between 1997 and 2008, most of the commercial research (pharmaceutical and surgical trials) I was involved with required research urodynamics; this was a central part of my research role and contributed to my growing expertise as a novice researcher.

Within these studies **(Papers 1–4)** my original contribution was that of primary data collector, where I was responsible for recording urodynamic investigations, providing interpretation and systematic analysis of the results. Latterly, I also contributed to the draft review of the papers prior to publication, where I was asked to review the paper and provide author confirmation of my role. This meant that I was accountable for setting up and checking the calibration of the urodynamic equipment prior to its use. This is a relatively simple but crucially important process, which is carried out during the initial set-up. The urodynamic pressure transducers are primed with room temperature sterile water, zeroed to air (atmospheric pressure), and set ready to record bladder (P_{ves}) and abdominal pressures (P_{abd}) through urodynamic catheters (Abrams, 1997). The check calibration process (Schäfer *et al*. 2002) ensures that all the pressures recorded are accurate – the pressure lines (P_{ves} and P_{abd}) can easily be raised above the zero point, where the corresponding pressure should always be equal when held at zero and in incremental increases to 50cm of water (using a simple 0-50cm scale). Following urodynamic protocols in this context therefore helped me to appreciate how scientific objectivity increased the likelihood of confirming reliability and validity of the research data (Waltz, Strickland, and Lenz, 2010), and subsequent study findings. Moreover, it contributed to my growing awareness of how urodynamic testing has evolved to answer a specific question or hypothesis – effectively, urodynamics are only useful if they are conducted with a 'urodynamic question' in mind, which either confirms or refutes the

initial hypothesis. I went on to use this expertise in all of the following research studies **(Papers 5, 7, 8, and 10)**.

Developing these practical calibration skills also enhanced my ability to recognise inaccurate pressure measurements, which was equally important and helped refine my technical troubleshooting expertise. This meant that I was starting to apply 'pattern recognition' skills (Liao and Schäfer, 2014), which is an advanced skill in urodynamics, and invaluable in research where accurate data collection is essential. Whilst urodynamics are generally reproducible in adults, there are known variables which are highly dependent on the investigator and the consistency of their urodynamic measurement techniques (Schäfer *et al*. 2002). Consequently, through my accumulated experience, I was able to provide detailed analysis of urodynamic traces for quality of measurement by checking the cough response, urodynamic trace characteristics and artefacts, based on normal urodynamic parameters for adults (Abrams, 1997). In turn this process advanced my understanding of the reliability and validity of the measurements obtained – essentially confirming that the test consistently measured bladder function accurately.

This process was influential in my learning, as I could now understand fully why capturing urodynamic data was particularly relevant in this instance. The results of investigations were subsequently compared to previous investigations that had been conducted with the same group of patients. Therefore, the reasons for providing accurate data collection (and subsequent data analysis) for this study became more apparent and gave a greater appreciation of why rigorous data collection methods from the outset were so important. Likewise, I had learnt that checking all equipment calibration and quality control measures before, during and after each test was a prerequisite to good clinical research practice. I now understood that following these processes provided greater assurance that the quality in measurement was sufficient to enable accurate interpretation of the urodynamic trace/results (Griffiths *et al.* 1997). The data collection process was pivotal to the study outcomes, on which the overall findings of the natural history of lower urinary tract dysfunction (LUTD) series of papers are based.

Nursing leadership in urodynamic research and clinical trials

The intervening years exposed me to an increasing range of quantitative methods where I undertook a greater leadership role as a senior research nurse in the BUI. In addition to

this, my professional role had changed (2000) to a combined clinical/research role during this time, which meant that I was working as a senior research nurse (2 days/week), and clinical nurse specialist (CNS) for urodynamics (3 days/week). As a research nurse, my principal contribution and link throughout all these papers was that of data collector and data analyst – arguably some of the most important roles in research, and often central to obtaining high quality reliable data in collaborative (NHS) and commercial (pharmaceutical/surgical) clinical research trials (Deave, 2005; Chatfield, 2008). Moreover, my experience in urodynamic research and clinical trials meant that I now held a more central role in the urodynamic data collection and analysis – to ensure trials were run safely, ethically, and adhered to the principles of research GCP.

Although research urodynamics was a predominant feature of my research activity, it was not solely limited to this. During this period I was also responsible for collecting and processing blood and urine samples, as well as conducting physical assessment of research participants (ECGs, vital signs) and organising the completion of research questionnaires e.g. bladder symptoms, treatment satisfaction, and the commonly used hospital anxiety and depression scoring (Zigmond and Snaith, 1983). Another feature of urology research is the completion of bladder diaries, which involve participant instruction and guidance, as they are often used as one of the primary outcome measures in clinical trials (Chapple *et al.* 2014). These rigorous processes meant that I was often involved in transcribing large amounts of data into case report forms, and required accuracy throughout to ensure detailed reporting within all the site files and clinical trial databases. By this stage in my research career, I had gained insight into the conduct of quantitative research, which transferred well into my further involvement with two non-experimental research studies with Hashim *et al.* (2005) and Garnett *et al.* (2009).

Paper 5 – My original contribution to this study was that of co-researcher (and second author), where I held a pivotal role in the study. This meant that I worked collaboratively with the first author (Hashim) throughout the retrospective review of urodynamic records to draw conclusions from this research, and the corresponding implications for practice. I was also involved in the critical review of the paper prior to submission for publication. My involvement with Hashim *et al.* (2005) resulted from my experience in paediatric urodynamics, which I had sub-specialised in since 2000. One of the concerns in children

with lower urinary tract dysfunction was calculating bladder compliance (Norgaard *et al.* 1998), as this can identify whether the related detrusor function is considered 'safe' or 'dangerous'. Left untreated, or undiagnosed, a high-pressure bladder can lead to dilation of the upper urinary tract/ureters, and potential renal function impairment (Houle *et al.* 1993). Consequently, it was important at the start of this study to consider the standard procedures required to provide interpretation and analysis of the urodynamic traces (Schäfer *et al*. 2002; Abrams *et al.* 2002). Manual urodynamic trace analysis, the only reliable method at the time of this study, was used in conjunction with some automatic urodynamic analysis KaleidaGraph Software (Synergy Software, Reading, PA, USA); this software was being trialled at the time to interpret a new concept in urodynamic analysis known as the 'area under the curve' (Groen *et al.* 1998).

We discovered early on in the study that the software could not reliably interpret the urodynamic data, as it was not capable of interpreting common trace artefacts (Abrams, 1997) e.g. movement, crying, or knocking the urodynamic catheters. I was aware (through my experience) that these artefacts were more common in children due to their age, their emotional response to an investigational procedure, and exposure to an often-unfamiliar hospital setting. As a result, the data was significantly compromised, which made automatic/software analysis extremely difficult, and severely affected the findings of the study. I was able to verify the accuracy and quality of the urodynamic traces through a manual 'eyeball' of each investigation (checking for cough response, interpretation of common artefacts etc.), to provide detailed hand analysis and interpretation of the remaining evaluable traces identified for the purpose of this study.

This can be a feature of non-experimental research, where there can be insufficient data to analyse retrospectively (Caruana *et al.* 2015). This was a useful lesson to learn, as this was the first time these records had been accessed, and highlighted the difficulties that can be encountered during retrospective analysis. The study was exploratory in nature, so we did not fully appreciate, or anticipate, the level of technical difficulty associated with paediatric urodynamics within the department – e.g. difficulty in obtaining accurate pressure measurements throughout a complete test, the combined length of a test (generally longer in children due to slower filling rates), interpretation of artefacts, and being able to conduct complete quality control checks during the investigation.

Nevertheless, we gained a unique insight into the early use of urodynamic software and its associated limitations, which also raised the profile of the 'area under the curve' concept in relation to bladder compliance in children. At the time of this study, there were no standardised methods of measurement for bladder compliance in paediatric urodynamics. Although there have not been any subsequent studies in children, the theory continues to be an area of interest and research in adults – notably those with neurogenic bladder dysfunction (Hidas *et al*. 2017). Similarly, these patients are also at risk of developing high-pressure bladders and renal function impairment.

The **seventh paper**, investigating the natural history of symptoms (Garnett *et al.* 2009), was a logical progression from the earlier research on men with lower urinary tract dysfunction – but the focus was on overactive bladder (OAB) symptoms in women due to idiopathic detrusor overactivity (IDO). During departmental 'away days' ideas for future studies in lower urinary tract dysfunction were discussed as a team. When I became the senior research nurse in the department I was frequently assigned to work with new research registrars (by Professor Abrams); so I could purposefully oversee their research projects. Although I was third author on this paper, I worked in close collaboration with the first author (Garnett) throughout, as they were relatively inexperienced in urodynamic procedures/investigations. Thus, my original contribution to this study was that of associate primary data collector; my experience with the earlier long-term follow-up series (**Papers 1–4**) meant that I could safeguard a systematic and robust approach to data collection, interpretation and analysis of the urodynamic traces. Correspondingly, as with the previous papers, I also contributed to the draft review of the paper prior to publication.

OAB is a condition that is usually characterised by a combination of lower urinary tract symptoms such as increased daytime frequency, urgency, urgency incontinence and nocturia (Abrams *et al.* 2002). Emergent theories on IDO at this point in time suggested changes in the smooth muscle and nerves supplying the bladder may cause increased spontaneous contractility, which can also be linked to spinal cord damage, hormonal changes in middle age women, bladder outlet obstruction in men, and anxiety (Steers, 2002). These symptoms were already known to have a significant impact on associated quality of life (Abrams *et al.* 2000). The rationale for this study was to gain a deeper

understanding of the natural progression of IDO, as the existing knowledge base was relatively limited (Garnett and Abrams, 2003). Since the publication of **Paper 7** (Garnett *et al.* 2009), there has only been one similar study that has explored the 'natural history' of OAB (Heidler *et al.* 2011) in any depth; this was based on the analysis of a health screening project and OAB symptoms in women, rather than women with a known urodynamic diagnosis of DO. The findings of **Paper 7** have informed subsequent research and current opinion on OAB **(Table 5)**; correspondingly, there is now a greater understanding of the symptom complex, which can be classified as a long-term condition. Recent publications relating to the assessment, diagnosis and management of OAB in women are therefore discussed in more depth in the research impact section.

Because of my previous experience, I was tasked to lead the urodynamic data collection process to provide detailed interpretation and analysis of the urodynamic traces. Additionally, the study increased my involvement in the informed consent process, which was an area in which I had become much more confident and proficient during the intervening years as a research nurse working in clinical trials. I was often required to speak to patients either in routine NHS clinics or following up telephone enquiries about research studies, which meant that I had to be fully conversant with the research protocols for each study. Developing a good rapport (and trust) with potential research participants was crucial to my role. This meant that I was able to explain all the standard commonly available treatment options and the research options, alongside the potential risks and benefits of each one, without personal preference or bias. The informed consent process became another important feature of my work as a researcher, and in effect, this was a natural progression and enabled me to become more attuned to the ethical considerations within clinical research.

Consequently, my role in ensuring participant information sheets (PIS) were given/sent to potential research participants was part of the informed consent process. This is a fundamental feature of all research, historically governed by the process of research ethics committee (REC) review, the Declaration of Helsinki (1964), and the International Council for Harmonisation (ICH) of Technical Requirements for Pharmaceuticals for Human Use (2005). I also understood by this stage of my development, that the human rights and ethical principles of research are paramount (Moule, 2018), and as a

researcher I was accountable for protecting the best interests of all participants at all times. Therefore, as a general rule, I would send out the PIS to all potential research participants at least a week before they were seen in a research clinic to allow them to be read and discussed with family/friends and/or GP. Occasionally, there was an opportunity to see patients in clinic, which I often preferred as it gave me an opportunity to meet them, explain my role, and give an overview of the study. It is vitally important to give potential participants time to read, understand what will be involved, and ask questions before informed consent is taken.

GCP training was a focal point in my researcher development, as I completed GCP updates every two years as a mandatory requirement for my role. This meant that I was up to date with what I need to know to conduct safe, ethical, and scientific research (International Council for Harmonisation, 2005; Department of Health, 2008) and these regular updates helped cement my existing understanding and knowledge of GCP. Subsequently, I developed greater confidence in my ability to provide assurance to potential participants that the study into which they were invited was conducted by researchers adhering to rigorous international standards. Likewise, this structured approach and ethical framework meant that I could correctly identify and recruit research participants, based on specific inclusion/exclusion criteria. This approach greatly assisted my review of hospital notes and patients' suitability for clinical trials; my combined research/specialist role meant that I was also often able successfully to recruit patients from routine NHS urodynamic clinics.

Participants for two of the following studies (**Papers 8 and 10** respectively) were primarily identified during their hospital appointments. These studies were conducted using experimental research designs – **Paper 8** was a randomised placebo controlled, 2-way crossover, proof of concept study, to investigate a new topical treatment gel (PSD503) for stress urinary incontinence (Robinson *et al*. 2011), and **Paper 10** was a simultaneous in vivo comparison of a medical device (Gammie *et al*. 2015). In both of these studies I was able to actively contribute to the research planning phases, based on my growing researcher expertise, where they were discussed in depth at the department away days. This also led to an invitation from Plethora Solutions (who were the trial sponsors, **Paper 8**), to work in an independent nurse consultant capacity to review the research proposal

and design, as well as the feasibility and related research resources required to conduct the study at multiple sites.

My involvement and engagement within the research-planning group (**Paper 8**) was due to recognition of my unique insights into the use and development of urodynamic research protocols for clinical trials. The trial design involved repeated standardised one-hour pad tests (Lose *et al.* 1988). This experience gave me a much greater appreciation of the variation in randomised controlled trial (RCT) design, as we were aiming to make it socially acceptable to patients eligible (and able) to take part in the study. This led to a unanimous agreement on a 2-way cross over trial design; so all the participants would be exposed to the PSD503 gel. Although I was fourth author on this paper, I was one of the primary data collectors (within a multi-centre study) and provided detailed interpretation and analysis of the study findings throughout.

I was responsible for conducting, completing and collecting the pad tests prior to application of the gel (baseline), and again one hour following application. Because of my experience in medical/pharmaceutical trials, I understood that timing was critical in all aspects of this study, therefore these tests were conducted alongside repeated (scheduled) blood sampling (full blood count, renal and liver function tests) and vital sign monitoring. Similarly, measuring the PSD503 plasma concentrations to assess the safety and efficacy of the topical application was an equally important part of the study. I had learnt that blood sampling was an important part of data collection and required diligent safe labelling (to maintain anonymity of the participants); this also required controlled safe storage and transit to an external laboratory for analysis. The PSD503 study data was all captured and recorded by myself in the individual case report forms (CRF) for each study participant, which was a requirement of research GCP (DoH, 2008).

Being closely involved in the research-planning phase **(Paper 8)** meant that I became responsible for the overall study co-ordination. Managing the participant recruitment and data collection (and their related study assessments) gave me a much clearer understanding of experimental research. RCTs are often seen as a more robust research method, and commonly referred to as the 'Gold Standard', mainly because they minimise the risk of allocation/treatment bias, which can potentially influence research outcomes (Sullivan, 2011). Conversely, they can be very intensive in terms of time, resources and

cost (Rosen *et al.* 2006). However, despite the initial deliberations over the study design, the recruitment was slow and the required sample size was not achieved within the timeline allocated, resulting in the early termination of the study. Predicting recruitment into clinical trials can be extremely difficult and challenging (Carlisle *et al.* 2015) and this may be due to a number of factors which may not be immediately obvious to the researchers: e.g. participants' fear of experimental research, or perceived impact on work/loss of earnings. Whilst I could easily identify a suitable patient population from which to recruit (women with stress incontinence), the required length of the visits (four hours) may well have deterred individuals from taking part, and the invasive nature of a topical vaginal gel may have been an additional negative factor.

These recruitment issues were unanticipated, and highlighted the complexity of planning, running and co-ordinating clinical research trials. This was an invaluable learning experience which helped me appreciate the patients' perspectives and the significance of their role in contributing to the development of novel therapies. Part of my lead study coordinator responsibility also involved providing regular recruitment updates to the trial sponsor, highlighting any areas of concern or issues that may have affected recruitment targets. In previous medical/surgical studies for stress urinary incontinence (SUI) with which I had been involved, recruitment targets were easily achieved; it was hypothesised (during a study team meeting) that women may prefer a more long lasting treatment effect than a topical gel providing short term relief from their symptoms. This caused me to reflect on the reasons why and when most women seek help for SUI, and how these link to available treatment options. Correspondingly, it was important as a researcher to consider why some patients will accept a clinical trial as a treatment option, and others will not.

Paper 10 – A cumulative range of research experience in the consent process and use of research urodynamics led to my involvement with the Gammie *et al.* (2015) study. Although I was fourth author on this paper, as highlighted in the previous studies, I was also a primary data collector, as well as facilitating the study through the process of informed consent with pre-identified participants. In this study I was invited to some of the early project meetings in the department (BUI) and at the International Continence Society Meeting (Beijing, 2012), with Andrew Gammie (first author), Professor Paul

Abrams, and Dr Tim McKinney, who invented the T-DOC™ air charged catheter technology. This was a medical device study, to evaluate a new type of urodynamic catheter (T-DOC™) – the air-filled catheter (AFC), and compare its performance with the water-filled catheter (WFC), as routinely used in UK urodynamic investigations (Abrams *et al.* 2002; Abrams, 2005). Prior to this study we had been engaged in discussion with the manufacturers and Dr McKinney, because the use of AFCs was somewhat controversial in relation to the existing guidance for good urodynamic practice and use of WFCs (Schäfer *et al.* 2002). Furthermore, as a researcher, I was aware that because this was a new device the evidence supporting their use was relatively limited (Cooper *et al.* 2011; Digesu *et al.* 2014).

One particular challenge of this study involved the consenting process, as it required an understanding of the complexities of urethral catheterisation, potential risks and side effects. I was in a position to undertake this process as I had an in-depth knowledge of urethral and rectal catheter placement, and related urodynamic research procedures. The technique for in vivo comparison meant that the participants would have four catheters in situ (two in the bladder, and two in the rectum) rather than the normal two, so there was an increased risk of urinary tract infection, pain or discomfort. This is a known side effect of standard invasive urodynamics (Onur, 2004), and the risk in this research study was relatively unknown. In terms of research ethics, as a researcher it is particularly important to understand the principles of 'do no harm' or non-maleficence, and when to act in the best interests of a participant (Moule, 2018). Patients had received the participant information sheets prior to me seeing them in clinic, so I was able to check that they had read the information and understood both the study and the potential risks. I also ensured that they received a copy of their signed consent form as a record of their participation in the study. Therefore it was imperative that the patients understood the associated risks of taking part before giving consent; it was equally important to re-iterate to the patient that the test could be stopped at any time.

I understood the concept of AFCs, and was fully trained in their use. I was responsible for conducting these tests in unison, which required a high degree of skill in positioning the urodynamic catheters. The same urodynamic protocols were adhered to as in the previous research studies (Schäfer *et al*. 2002; Abrams *et al.* 2002), so the results were

likely to be more reliable in terms of their measurement and quality control throughout the investigation. In-vivo testing was not an area that I was familiar with, so this was a very good opportunity for me to further develop my urodynamic research experience. I approached the study cautiously as I was aware that there might be difficulties in urethral catheter placements. It was important to ensure there were rigorous quality control checks before, during and after the investigation, as the presence of additional catheters could affect bladder function adversely and alter the overall urodynamic diagnosis. Furthermore, it was essential to analyse the urodynamic traces carefully and consider the urodynamic findings in relation to the presenting urodynamic question – i.e. the overall findings correlated with the patient's history and symptoms.

In vivo comparison testing of WFCs and AFCs was a pragmatic approach to assessing these new urodynamic catheters, and added a valuable contribution to the somewhat limited evidence base. Since this publication, the debate on their use has continued. Abrams *et al.* (2017) conducted a literature review, which concluded that there was not enough evidence to recommend the use of AFCs in routine urodynamic investigations; the evidence on their clinical utility is limited, and calls for further research. Likewise, this review was further supported by the ICI-RS think tank on the validation of new urodynamic methods (Harding *et al.* 2018), which recommend further research that is ethical, robust and follows rigorous scientific testing methods in laboratory and in vivo conditions. Their use would also need to be evaluated in male patients, and more complex/advanced urodynamic investigations e.g. the assessment of neurological patients, and ambulatory urodynamics. The controversy surrounding the adoption of AFCs has stimulated further research to address the concerns commonly raised over their use.

These studies were swiftly followed by the Couri *et al.* (2018) study that looked at 180 T-DOC™ AFCs, which were tested under laboratory conditions. Although this study reports AFCs met the technical requirements required for urodynamic pressure measurement, the findings are limited as they were not exposed to the physiological variations of in vivo testing, or compared with WFCs. Further research undertaken by McKinney *et al.* (2018), which has followed on from **Paper 10** and our earlier work (Gammie *et al.* 2013), used the same statistical power calculation and in vivo testing methods in women, where they

have achieved comparable results in pressure measurement. However, their more recent research has observed greater variability in pressure measurements under bladder volumes of 50ml. Interestingly, this finding correlates with the historical use of Gaeltec™ micro-tip transducer catheters in urodynamics, where the bladder needed to filled to 100ml initially (Abrams, 1997) to ensure accurate pressure readings – this also relied on accurate positioning of the micro-tip transducer catheter. The Gaeltec™ catheters were commonly used in routine urodynamic practice in the UK, and were superseded by the recommendation of WFCs in the 2002 Good Urodynamic Report (Schäfer *et al.* 2002).

Advancing urodynamic practice – Translating research into practice

Taking my first step into conceiving, designing, and planning my own research projects, where I was the lead researcher and first author, evolved from my interest in the urodynamic education and training needs of HCPs. This was also heavily influenced by my earlier contributions to research in the BUI, and my ability to generate original ideas for future research. Individual and team research projects were actively encouraged at department away days; these experiences developed my critical awareness of practice related issues and desire to undertake my own research for the first time. As a tutor on the certificate in urodynamics course, I saw an opportunity to follow-up delegates who had attended and completed the three-day course in Bristol. Primarily, this was motivated by my discussions with course delegates during practical 'hands on' training sessions, whose common concerns focussed on their existing knowledge and ability to conduct, interpret and report their urodynamic investigations. After this, student assessment of the course was conducted through simple course evaluation forms on the final day, so there was no way of knowing how this new knowledge translated into practice. At this juncture, there seemed to be a theory/practice gap, and this was when I proposed a more formal approach to assessing the impact of urodynamic education and training on clinical practice (Ellis-Jones, Swithinbank, and Abrams, 2006), to enable a more critical review of the course **(Paper 6)**. Leading this research was a natural progression for me as I had acquired a useful range of researcher skills in the preceding years; this research study was undertaken shortly before I started my MSc Advanced Practice programme in 2004.

Urodynamic investigations require a high level of skill and competency, and I was familiar with an earlier survey of UK urodynamic personnel (Hosker *et al.* 1997), where over half of the respondents had identified their professional training as inadequate. On a personal level, I felt this had significant implications for professional practice as well as patient experience and related urodynamic outcomes. This experience highlighted three major factors in my research-planning phase – the research had to be feasible in terms of (i) design, (ii) cost and (iii) relevance to current practice. Therefore, the simplest and most cost-effective approach was a postal survey questionnaire. The Hosker *et al.* (1997) study had greatly influenced my decision on the research design for **Paper 6**, as this approach seemed relatively straightforward to me at the time. Similarly, as a nurse researcher, I felt comfortable using non-experimental research methods where I was also used to working with validated questionnaires, so I felt this would be an appropriate data collection method for my study.

Course participants **(Paper 6)** already received a pre-course questionnaire prior to starting the course. As there was no specific validated questionnaire to use in this context, the post-course questionnaire was designed around the pre-course version. I had discussed the data analysis with colleagues and a statistician at the time, which resulted in the re-use of the same visual analogue scales and paired questions within the questionnaire; these were subsequently analysed with Wilcoxon signed rank test and McNemar's Test to test for exact level of significance. Consequently, I gained valuable insight into how these tests can help measure the differences between paired sets of measurement (Walker and Almond, 2010), allowing direct comparison before and after urodynamic education and training. This was the first time I had considered which type of data analysis methods to use in any depth, but I had enough insight to consider how I could analyse the data during the preliminary stages of the study design. I appreciated that visual analogue scales (VAS) were commonly used in healthcare research surveys to measure respondent traits (Streiner, Norman and Cairney, 2015), therefore using this approach provided a relatively simple way of rating knowledge and confidence levels pre- and post-course attendance. However, I was aware that the uses of VAS can potentially be limited and are not without criticism; there are a number of factors that can influence

the respondents in their responses such as the choice of ratings, type of scale, and respondent's motivations (Sung and Wu, 2018).

In this context, using a cross-sectional survey questionnaire provided a relatively quick and easy option for gathering information about course delegates, which could answer the underpinning research question; as a developing researcher this highlighted the many advantages of using this approach. Survey research can usefully provide a range of information about knowledge, attitudes, and prevalence (at a given point in time), and can therefore focus on a wide range of questions economically (Polit and Beck, 2017). Likewise, surveys can be conducted on a large scale, where they can easily provide a representative sample of the study population; consequently these findings can be generalisable to the wider population (Moule, 2018). However, it is recognised that their scope may be limited, as the survey response rates can be low (Polit and Beck, 2017). There was also the associated risk (or potential) for responder bias, which can occur as postal questionnaires are self-administered, and the respondents are self-selecting. Similarly, the questionnaire design itself may affect reliability and validity of the findings (Parahoo, 2014), so the questionnaire should be accompanied by clearly written simple instructions on how to complete it.

Crucially, with these factors in mind, I had taken some time to pilot the questionnaire on colleagues working in the department before they were sent out to the study participants to check for ease of completion, readability and structure. Likewise, as I developed my understanding of cross-sectional survey research, I was aware that I needed to consider the time window in which I could send out the postal questionnaires (with a stamped addressed envelope). This was just after Christmas (as opposed to before) to help maximise the response rate; a reminder letter (with a second questionnaire enclosed for participant convenience) was also sent out four weeks later to encourage any late or non-responders to participate. It is important to note that this was the first study in the UK to follow up the outcome of formal urodynamic education and training courses, and the subsequent findings provided a unique perspective on how these courses translated knowledge into everyday urodynamic practice.

Following on from this study, I identified another research project (dissertation) for the final year of my MSc in 2007 **(Paper 9)**. At the same time, I was awarded funding

following a successful application to the Florence Nightingale Foundation. Subsequently, the completion of this project also led to the prestigious lifetime award of Florence Nightingale Scholar. Although I had increased my researcher knowledge during the previous study **(Paper 6)**, I was still learning about the relative strengths/limitations of quantitative research design and methods, which helped me adopt a more reflective approach to research. This meant that I could think more clearly about what had worked well in the past, and what did not (and why); being reflective enabled me to be both proactive and reactive to my own research as it evolved. As a result, I was able to adopt a solutions-based approach to conducting urodynamic research that was ethical and reliable. Ultimately, I was governed by how I could generate new knowledge and add value to existing research in the field. The decision to use a mixed-method research design stemmed from an interest in gaining a deeper, qualitative understanding of urodynamic practice in the South West NHS region. I was also drawn to mixed methods as a research design, following the completion of one of the research modules on the MSc programme. This was when I first realised the potential for combining quantitative and qualitative methods, and how the triangulation of the two data collection methods could provide me with more meaningful data (Polit and Beck, 2017).

Paper 9 represents my second venture into leading research (Ellis-Jones, Swithinbank, and Abrams, 2013), and used a mixed methods research design. This approach uses a variety of data collection methods and can potentially provide a more robust form of research (Moule, 2018), and generally combines quantitative and qualitative research methods (Östlund *et al*. 2011). The primary benefit of using this approach in this context was that I would be able to gather extensive data (through a cross-sectional postal questionnaire survey), as well as further interpretation of the data (and finding depth of meaning) through the subsequent follow-up telephone (semi-structured) interviews. I had discussed the strengths and limitations of this approach with my dissertation supervisor. The advantages of using semi-structured interviews were that I could work with a prepared interview schedule of open-ended questions (which was based on the questionnaire content to explore these questions in more depth) and this enabled me to prompt further discussion on current urodynamic practice by HCPs and the specific challenges they were facing individually. I was also covering quite a wide geographical

area; travelling to the interviewee's place of work would have been costly in terms of time and travel, so a pragmatic decision was made to use telephone interviews. Potentially, semi-structured telephone interviews can be more challenging for the interviewer, as there are no visual or non-verbal clues (body language) to help ensure questions have been understood (Moule, Aveyard and Goodman, 2016). However, this can be outweighed by the benefits of greater anonymity and freedom to speak, as well as being less physically intrusive to the participant (Parahoo, 2014).

Prior to arranging the interviews, I ensured that I was conversant with all the processes that I would be following at the time of the interview – checking informed consent prior to starting each interview (which in this case was recorded), giving them time to ask questions before I started, and explaining what would happen with their data in terms of confidentiality. In general terms, this was similar to my previous experience of informed consent processes. The main adjustment was in not being able to see the participants, particularly as one of the participants was quite 'monosyllabic' in their answers, which made me feel uncomfortable – I was not sure if this was my interview style or whether this was normal behaviour for them. Of all the interviews this was the only one that had made me question my ability to conduct qualitative interviews, which slightly knocked my confidence at the time. Conversely, the remaining interviews were relatively straightforward. The interviewees seemed engaged, interested, and able to provide detailed insight into issues that either positively or negatively influenced their current urodynamic practice.

During the interviews I kept 'field' notes (Phillippi and Lauderdale, 2018), which helped me to identify context and key points that may be useful in the subsequent analysis. After each interview I listened to the recording again as soon as possible, whilst the interview was still fresh in my mind, so I could edit my field notes and make notes of time points during the recording to which I could potentially refer for direct quotes or clarification of content. This was quite a laborious process, but it helped immerse me in the raw data and gave me some initial impressions of the participants' thoughts and feelings. Transcribing these interviews involved several meticulous steps, but the initial transcription was undertaken by one of my administration colleagues, employed by the BUI to help with data analysis. Once transcribed, I checked them all for content, and the

field notes provided a useful reference for me to confirm content/key points. All the interviews were then subsequently analysed using a framework approach (Gale *et al,* 2013), which facilitated the initial coding and grouping of themes, and enabled me to identify emerging themes. This is a recognised technique in thematic analysis, and initially I had found the amount of data quite overwhelming. As I was new to this method of data analysis, a secondary analysis was also undertaken by my dissertation supervisor to check that my interpretation (and generated themes) constituted an accurate representation of the data. Using a structured framework supported me throughout the lengthy interpretation of the data. Thereafter, this allowed me to identify emerging themes with much greater confidence as the approach kept me firmly focused on the task.

Up to this point I had primarily been a quantitative researcher, but I could now see clearly the value of designing a study using two data collection methods, which could add depth to my research question. Although the guidelines for good urodynamic practice (Schäfer *et al.* 2002) had been published in the preceding years, there was still anecdotal evidence from course delegates to suggest that they were not easily being translated into practice. I was familiar with working with current standards and guidelines, but evidence from my previous study **Paper 6** (Ellis-Jones, Swithinbank, and Abrams, 2006) suggested that there was still a wide variation in urodynamic practice in the UK; this was also a 'hot' topic of discussion nationally. During this time frame I had become more conscious of the evidence base and joined the United Kingdom Continence Society (UKCS) working group to determine minimum standards for urodynamics in the UK (Singh *et al.* 2010), which were harmonious with my own values and beliefs and published soon after my research.

Collectively these studies, which were particularly useful in providing an up-to-date analysis of current practice, highlight my work as first author – **Paper 6** (Ellis-Jones, Swithinbank, and Abrams, 2006) and **Paper 9** (Ellis-Jones, Swithinbank, and Abrams, 2013) respectively. I had learnt how to structure the papers from reading the author guidelines for each journal, which were very clearly laid out, and through accessing literature on writing for publication (Albarran and Scholes, 2005). I was also supported by the draft review of my earlier publications, gaining general experience in reading research papers, and writing abstracts for conferences. This was a natural progression for me, and latterly contributed to my first experience as a joint author for a **book chapter** on

urodynamics for the Oxford Textbook of Urology (Ellis-Jones and Hashim, 2017). Writing for a core urological textbook only became achievable when I became known as a clinical specialist and nurse researcher – these roles were mutually beneficial. By 2013, I had achieved many of my personal goals and published within my field and scope of expertise, by attaining the skills required to plan, design, conduct and appraise existing research; these were fine-tuned by my ability to translate research findings into practice. The opportunity to write for such a well-respected urology textbook was not only a reflection of these achievements, but a significant career highlight and honour.

Between us we shared the responsibility of deciding the order of content, as well as the choice of supporting figures to illustrate key concepts, equipment, and urodynamic traces. The content was based on the existing evidence base and published literature for urodynamics, and also utilised our collective clinical experience and opinion. Creating the structure for the chapter was relatively straightforward as there is a fairly logical sequence for invasive urodynamics, which fall into three categories – basic, complex and advanced (Schäfer *et al*. 2002, Abrams, 2005). This included the principles of good urodynamic practice, aims and indications. As I was conversant with both the research and current theories relating to urodynamic practice, we were able to present the most salient facts, with a clear rationale for each category of urodynamics. This is an important feature of a reference textbook, and as a researcher I could appreciate that this was akin to writing up research methods. The approach to urodynamic investigations needed to be consistent, and ultimately the methods should be reproducible in day-to-day practice.

Core reference textbooks provide an additional source of evidence, usually based on recent research, expert opinion, current guidelines and standards for practice (Aveyard, 2014). Reference textbooks are often referred to as secondary evidence (NICE, 2015), and provide a more 'integrated' view of the subject. However, the experience of writing a book chapter made me realise that reference textbooks could easily become out of date; in this context the process of writing had started in 2012, with the resultant publication in 2017. Interestingly, it became apparent in 2016, with an email notification from the publisher, that some contributors had raised concerns that their chapters were becoming out of date, which contributed to a further delay in the publication date to allow chapter revisions.

Notably, within this timeframe, the ICS urodynamic committee (Rosier *et al.* 2017) had revised the seminal good urodynamic practice guidelines (Schäfer *et al*. 2002). Although this long-awaited revision was anticipated, in this instance it was too late to incorporate them in our chapter due to the publishing deadlines for final print. This experience highlighted the complexity of capturing all the latest evidence, and as previously mentioned the full impact of new guidelines can take considerable time to translate into practice and appear in core textbooks. Although concern has been raised in the literature about the scientific content of medical textbooks, where there is a risk of being 'out of sync' with other contemporaneous works (Rennie and Chalmers, 2009; Jeffery *et al.* 2012), they do provide a useful resource and overview of a topic. Certainly in my early researcher career textbooks were often my first reference point, mainly because I did not have enough confidence or knowledge to be able to appraise primary research papers in a reliable way.

In summary, this section has demonstrated how I have engaged in a range of methodologies, and provides an integrated thematic overview of my portfolio of published work through a critical narrative and analysis. These publications showcase my original scholarly contribution to research and the associated development of new knowledge, which were peer-reviewed by experts in this field. Several key concepts emerged within these themes:

- A deeper appreciation of the role of urodynamics in clinical research, their relevance, and how they were useful in developing a greater understanding of lower urinary tract dysfunction.
- A critical understanding of my role as a nurse researcher – the interrelated significance of my function and contribution to leading research in urodynamic practice.
- The impact of urodynamic education and training and how this supports the translation of research evidence into current practice.
- The identification of factors that can affect the ability of HCPs to adhere to the principles of good urodynamic practice, and how this body of work contributed to a growing national and international agenda.

Reflection on the portfolio of publications, methods and research philosophy – completing a doctorate of philosophy through a portfolio of published work

In this section I will showcase how through my engagement with a range of research inquiries, I have developed a depth of understanding and insights in relation to ontological and epistemological positions. As an individual, I have developed with the theories of reflective practice, which provided a strong foundation for my research nursing practice; being reflective is frequently linked to the development of professional knowledge (Kinsella, 2009; NMC, 2015). Accordingly, I have taken considerable time to bring together this portfolio of published work into an organised format. Therefore, I will reflect on my approach to collating this body of work the process of writing my DPhil, and how I have prepared the evidence in support of my submission for a Doctorate by publication. This also includes a review of the methods and underpinning research philosophy, and the related challenges and breakthroughs of completing this critical commentary.

Considering my approach, reflecting on my choice of publications, and writing a critical commentary

There are several approaches to completing a DPhil though published work (Smith, 2015), which are generally undertaken through the retrospective or prospective route; so it was essential to be conversant with the current guidance (UWE Doctoral descriptors, Appendix Two), and methods of inquiry used in this approach. The descriptors for DPhil by publication are clearly defined, where three of the most important criteria that must be illustrated are those of originality, rigour, and significance (Badley, 2009). Consequently, I needed to identify my choice of selected publications early on in the application and registration processes, so that I could organise my collection of work into a meaningful synthesis – based on the core theme of urodynamics and my role as a research nurse. I had read extensively on the DPhil by published work approach and recognised that I was aligned with the retrospective route (which I had also discussed with my Director of Studies), and aptly fitted my research publication profile (Smith, 2015; Peacock, 2017). It was slightly confusing at the beginning of this process, as the terms ‘DPhil’ and ‘PhD by published work’ are used interchangeably between universities; likewise, the DPhil requirements also vary between universities in the UK.

In developing the structure of my commentary, which would ultimately help justify and support my application for the award of DPhil, one of the initial hurdles for me to overcome was my close proximity and familiarity with the published work. The challenge at this stage was effectively to 'unpick' this work, viewing it from a research apprenticeship perspective to help me create a coherent chronological narrative. In this context, I was effectively providing an autobiographical account of my research journey from a novice urology nurse researcher to senior nurse researcher. In a part of my prior academic learning I had studied reflective theory and reflective models during my MSc, notably Kolb (1984) and Gibbs (1988). These supportive frameworks have also helped guide me through a more structured reflection on my role as a researcher, and my professional development as a nurse academic. Similarly, I could see a professional development parallel with Benner's (1982) theory of skill development and clinical competence. This enabled me to draw comparisons between my novice researcher years, and my transition from novice to advanced practice through an evolving continuum of research skills, knowledge and expertise. Revisiting my published work in this way allowed me to reflect on my original contribution to the research, as well as gaining a deeper appreciation of the underpinning research philosophy, which has furnished me with a new perspective on my scholarship. Previously, as a lead and co-author, I had neither fully appreciated the full significance of my research contribution, nor recognised the value of my assimilated learning and how this has transferred into my development.

Moreover, I knew that I needed to conduct a literature review to re-evaluate the current views and opinions at the time this research was undertaken; the publications drawn on here cover thirteen years, from 2004–2017. Throughout this time frame I developed a highly specialist knowledge of urodynamics and lower urinary tract dysfunction, so it was equally important to consider how this growing expertise influenced my understanding of research design, methods, data collection, and analysis. Nonetheless, it is important to note that the level of evidence hierarchies and grading scales have also evolved during this time (Wyer, 2018), and this change holds greater significance both in the analysis of the impact of this research and translation of the embodied evidence into practice (Mackey and Bassendowski, 2017), which will be discussed in a subsequent section (p.42). Once I had established my portfolio of publications, I wanted to create a critical narrative

that provided the background to my development as a researcher, explained the research setting (the BUI), and the nature and context of urodynamics in relation to lower urinary tract dysfunction. This approach provided me with the perspective that I needed, and a strong foundation for the combined analysis of my publications. I was also guided by the UWE doctoral descriptors (Appendix Two), which gave me the supportive framework I needed to shape my narrative.

Uncovering the contribution of philosophical positions in research

Philosophy, in this context, is essentially the underpinning research thinking (or set of personal beliefs) that includes two elements: ontology addresses the way individuals view the world as researchers and their perspectives on reality, whereas epistemology is concerned with theories of how our knowledge relating to the area under study is gained (Howell, 2013). As a researcher it is important to understand that our philosophical viewpoints are unique and relate to our individual experiences, values, beliefs and professional influences. Arguably, as it was in my case, it can be difficult for novice nurse researchers to understand the difference between quantitative and qualitative philosophies (Crossan, 2003), e.g. positivism and interpretivism. My initial understanding of the research methods was relatively limited, which meant that there was an element of 'do' rather than 'think'; as a result, it was difficult as a research nurse critically to analyse and debate the wider theoretical perspectives. This is often referred to as the 'research paradigm', which combines ontology, epistemology, and methodology perspectives (Kelly, Dowling and Millar, 2018).

Joining the BUI research team had a significant influence on my appreciation of research, because I was still developing my own set of assumptions, values and beliefs. Up until this point, I had rarely taken into account a deeper ontological and epistemological view of the related theoretical perspectives, which can inform the choice of a particular methodology (Weaver and Olson, 2006; Ryan, 2018). This critical understanding was meaningful, as I became increasingly aware of how each research paradigm could influence the way the research was conceptualised, conducted, analysed and reported. Whilst I did not have any particular philosophical stance or viewpoint at this stage, I could appreciate the positivist philosophy was scientific, objective and dependent on the use of valid and reliable data collection methods. Positivism is often associated with the 'natural

sciences', which are focused on studying observable natural phenomena using experimental research designs, and judgements can be made about the related study findings (Bunniss and Kelly, 2010). So where there is an identified knowledge gap, or unanswered question about practice, the contribution of research is to add and enrich understanding for the wider benefit of society.

This made a great deal of sense to me, as measurement and observation are fundamental to good nursing practice; equally they are core to positivist research. So, I could fully appreciate their significance, the need for accuracy, and an unbiased objective approach to data collection, and the use of controls in RCTs. As I became more experienced I understood the rationale for using these methods within experimental and non-experimental research designs. Accordingly, I could fully appreciate how this detailed approach added strength to the reliability and validity of the data collection, combined with the rigour of structured analysis could promote confidence in the results (Waltz, Strickland, and Lenz, 2010). This was particularly apparent in **Papers 1–5, 7, 8, and 10**. The completion of an M-level research methods module in 2006 further added to my understanding on how the values of each paradigm can provide the researcher with a more holistic and informed view on research.

Alongside my personal view on positivism (which is the common thread through this body of published work), this retrospective reflection and critical analysis also includes engagement with other research philosophies. For example in **paper 9,** I touch on interpretivism by using quantitative and qualitative methods. This research was conceived following my first experience as lead researcher **(Paper 6)**, which had utilised my experience in non-experimental research design. **Paper 9** was my first foray into leading mixed methods research design, where I was looking for a deeper understanding of HCPs' individual experiences through semi-structured interviews. Interpretivism, which can focus on 'lived experiences', allows the researcher to acknowledge and accept the possibility of multiple realities or participant outcomes (Welford, Murphy and Casey, 2011). This philosophy accepts a much more individual and subjective stance, which can capture detailed personal perspectives. Equally, interpretivism necessitates a qualitative methodological approach, to enable greater understanding of each person's (participant) experiences, explore how and why things have occurred (social processes), and provide

depth of meaning (Bunniss and Kelly, 2010). It was a particularly useful learning experience for me as I was beginning to develop the skills of a qualitative researcher, and I could start to understand the quantitative findings of this study in much more depth. This was quite a revelation, as I found that not only did I enjoy using this approach, but I also felt very privileged to be able to gain the participants' trust, as this allowed them to share their personal experiences, feelings, and deeply-felt frustrations. As a result, I could now reflect on the strengths and limitations of each paradigm, and thereby appreciate how different methods complimented each other in the interpretation of data and subsequent analysis. Conversely, although I was aware of the benefits of mixed methods research, I was also conscious of the subjectivity of qualitative research methods in relation to quantitative methods, which are highly objective.

I had also developed my knowledge of researcher bias, which could also occur at any stage of research from the research design/planning phase, through to the data collection/analysis, and interpretation of the findings (Pannucci and Wilkins, 2010). I understood that there was the potential for researcher bias within these studies **(Paper 6 and 9)**; an important consideration in any research paradigm. Fundamentally, I have always felt that being an ethical researcher is paramount, and this is where I understood the necessity for clear reporting of the methods used, and the associated strengths and limitations of my approach. My responsibility as lead researcher was to demonstrate rigour and trustworthiness within my research, and I aimed to be open to further scrutiny and peer review. Developing an understanding of the different research paradigms has become an important part of nurse education (Houghton, Hunter and Meskell, 2012; Kelly, Dowling and Millar, 2018), and this was absolutely pivotal to my advancing role. Consequently, I can now relate this experience to reading and interpreting research outputs in an informed and systematic way, with the capacity to be 'critical' of the researcher's paradigm (and conflict of interests), together with their design (methodology), and methods.

I am mindful of how this experience has influenced my approach to research and how, as a result, this has provided me with a degree of methodological openness. Whilst I do not think I have a strong allegiance with any particular paradigm, I can appreciate the fact that I am rooted in positivism. Since 2004, and in my subsequent experience as a

developing researcher, I have unconsciously adopted a pluralist approach to a range of research methodologies. Part of that belief has probably been shaped by my attendance at study days and conferences, where I have had the opportunity to listen, observe, and engage in the critical appraisal of a wide range of research and associated research methods. Crucially, I have learnt that, although the research question will ultimately decide the choice of paradigm, the complex and changing nature of healthcare requires methodological openness to find the answers needed to inform practice in a more holistic way (Loughlin *et al.* 2018). Ultimately, this means that I can reflect on my own set of values and beliefs, whilst appreciating different philosophical perspectives. This will undoubtedly help me consider the choice of research design in future collaborations and research.

A final reflection on the challenges and breakthroughs of completing a doctorate of philosophy

I have experienced many challenges in completing this DPhil. Currently, as I work as a full-time nurse academic, this has predominantly been finding enough protected time to study and complete this body of work; but the second most challenging aspect was developing the style and structure of my synthesis. There are many DPhil examples to refer to in the UWE library (theses) as well as open access online publications, but I found that they were all very different, which naturally highlights the original contribution of their work and the complexity of completing a DPhil by published work. There was no obvious structure, and throughout my career I have been used to writing in a very structured format. To get me over this difficult hiatus, I returned to mapping frameworks (Smith, 2015), which I had used during my MSc. I was familiar with mind mapping techniques (Buzan, 1974), spider diagrams, and free writing (Li, 2007), which helped organise my ideas, generate themes and 'golden threads', to keep my writing focused. This process helped me reconnect with my research, which gave a new and fresh view on how to proceed; primarily by re-reading all my publications and related literature, which influenced this research at the time it was undertaken. Once I had re-evaluated all my published work, which I detailed in some personal reflective notes, I was able to think in a much more coherent way and explore the relationship between each paper, so as to establish their overall connectivity. I recognised that there were three distinct sub-

themes within my core theme of research urodynamics: my 'novice years', the middle years – where I held a more senior role leading research, and the advanced practice years, which translated my research knowledge into theory and practice.

Correspondingly, one of the major breakthroughs in preparing this DPhil submission relates to how these findings have been translated into practice, which will be illustrated in more depth in the following section on research impact (p.42). In healthcare, one of the common difficulties encountered with conducting research is the related translation of research knowledge into current practice guidelines, education, and policy (Grimshaw *et al.* 2012). I became aware of this when working with HCPs on training days, courses and conferences – it became evident that they were not always familiar with current research, nor could they appreciate how using the existing evidence-base can influence change in practice. In the wider research team, it was often assumed that guidelines and policy were common knowledge, but the reality was that they were often not, largely due to the time constraints that HCPs face in practice, which were highlighted in **Paper 9**. As a result, I was able to appreciate that I have been in a unique position – a role that combined being a researcher and a clinical nurse specialist; I was incredibly fortunate that my research experience and knowledge informed my practice and vice-versa. Moreover, this enhanced my ability to translate good urodynamic practice guidelines into teaching and learning resources for the assessment of lower urinary tract dysfunction.

In summary, this reflective account summarises the complexity of completing a DPhil through published work. I have realised that this approach to critical writing and narrative was very different to academic writing in the first or third person, but naturally combines elements of both. Similarly, finding the style and structure was another major milestone for me, and it was at this point that I could start to see the 'golden thread'; this helped me identify the common theme and sub-themes, so that I could convert these publications into a coherent and connected body of work. In retrospect, this is where a considerable amount of learning has occurred. I feel incredibly fortunate to have had the opportunity to revisit my publications and re-evaluate the methods and underpinning research philosophy. Lastly, I have been able to take the time to reflect on how my journey gives me a much broader perspective of my original contribution to research, and the capacity to recognise the internal and external influences on my development as a researcher.

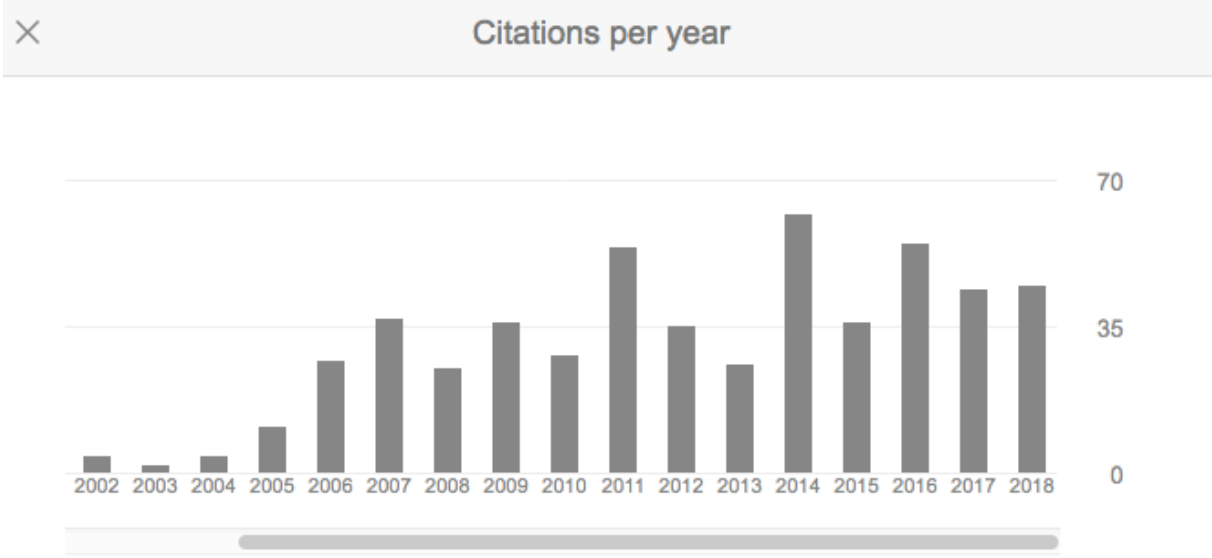
Research Impact and Knowledge Mobilisation

The following section outlines the impact of my published work and how the subsequent research findings have been translated into current practice. Measuring research impact (RI) generally utilises a range of bibliometrics (e.g. citation counts, journal impact factors), which are often useful in the context of healthcare as they provide a 'quantitative' but broad measure of individual research outputs. However, like any quantitative measure they should be interpreted with caution and within the context of current evidence, expert opinion, and professional judgement (Butler *et al.* 2017). Whilst measuring RI provides valuable information about published work, knowledge mobilisation (KM) relates to the additional scholarly activities involved in disseminating the research findings to the wider audience (students, colleagues) at local, national and international meetings or conferences. As a researcher, it was important to be able to understand how these processes can help translate research evidence into practice, inspire future research, and develop evidence-based educational initiatives.

Bibliometrics: In this instance, I decided to use the Google Scholar™ citation service to help analyse my research impact (Google Scholar, 2018), which is one of a number of bibliometrics (metrics) tools available to track and measure RI. This gave me free access to the number of current citations relating to my published work, in addition to some of my other publications which were not included in this portfolio. The number of citations was relevant as this provided me with some measure of research impact within urology and urodynamics, based on the frequency of citations within other published work. The table below **(Table 2)** shows the number of citations by year, which illustrates my RI within the context of past and current practice. Similarly, the journals also provide useful information on their journal impact factor (JIF) each year, and thus the potential level of influence on other practitioners and researchers within this specialist field (Garfield, 2006). Within my publications, the BJU International had the highest calculated JIF with 4.688 (2018), followed by Neurourology and Urodynamics at 3.263 (2018). The lowest JIF was the International Journal of Urological Nursing with 0.177 (2017/18). Whilst these factors will help to provide some indication of the quality of the journal, which may also influence the researcher in their choice of journal for their manuscript submission, they

are not an indicator of an individual's (researcher) scientific merit or the quality of their research outputs (Greenwood, 2007; Bornmann *et al.* 2012).

Table 2: Google Scholar™ – Citations per year



Undertaking a critical review of these bibliometrics allowed further scrutiny of my citations. I have been able to assess their impact and correlation with other contemporaneous works relating to urodynamics and lower urinary tract dysfunction. Following this process allowed me to identify the papers with the most frequent citations to ascertain how, when and why they had been cited. Consequently, I could begin to appreciate the impact of my research since the publication of my first paper in 2004. Latterly, these metrics and research outputs also conveyed valuable performance indicators for the UWE Research Excellence Framework (REF) submission in 2014, which included three of my more recent publications (**Papers 7 – 9**). Being part of the REF submission highlights my individual research output, whilst acknowledging my RI outside the university setting (The Research Excellence Framework, 2018). Within this body of work, REF links my role as a researcher in the BUI, and transition to senior lecturer in higher education at UWE.

Understanding and interpreting research impact

In total, my combined portfolio of publications has currently been cited 505 times (Appendix 3), as of November 30th 2018. It is not possible to review all these citations individually but I have selected the ones which I believe illustrate the greatest impact of

this body of research. Two of the papers **(Papers 1 and 2)**, are now considered 'seminal' work, as they have become pioneering research studies (Herrmannova *et al.* 2018) in the urodynamic assessment of LUTS. With regard to **Paper 1**, the main perceived influence (cited 170 times) has been the contribution of knowledge and understanding of the prevalence of DUA in men with BOO, and how DUA can impact on the surgical outcomes of men post TURP. Similarly, **Paper 2** (cited 143 times) captured TURP surgical outcomes in men with a sole diagnosis of BOO. The research was significant as it provided a unique insight into men who had been given a urodynamic diagnosis of BOO (with or without DUA), which now contributes to the overall assessment and management of men with LUTS. Since 2004, this research has been translated into clinical practice guidelines, where BOO and DUA remain a topic for discussion (in relation to men presenting with LUTS) at an international level **(Table 3)**, notably:

Table 3: Citations appearing in guidelines for urodynamic assessment – evaluating men with LUTS

- Gratzke, C., Bachmann, A., Descazeaud, A., Drake, M.J., Madersbacher, S., Mamoulakis, C., Oelke, M., Tikkinen, K.A. and Gravas, S. (2015) EAU guidelines on the assessment of non-neurogenic male lower urinary tract symptoms including benign prostatic obstruction. *European Urology.* 67 (6), pp.1099-1109.

- Homma, Y., Gotoh, M., Yokoyama, O., Masumori, N., Kawauchi, A., Yamanishi, T., Ishizuka, O., Seki, N., Kamoto, T., Nagai, A. and Ozono, S. (2011) Outline of JUA clinical guidelines for benign prostatic hyperplasia. *International Journal of Urology.* 18 (11), pp.741-756.

- Mangera, A. and Chapple, C. (2015) Update summarising the conclusions of the international consultation on male lower urinary tract symptoms. *World Journal of Clinical Urology*. 4 (2), pp.83-91.

- Winters, J.C., Dmochowski, R.R., Goldman, H.B., Herndon, C.A., Kobashi, K.C., Kraus, S.R., Lemack, G.E., Nitti, V.W., Rovner, E.S. and Wein, A.J. (2012) Urodynamic studies in adults: AUA/SUFU guideline. *The Journal of Urology.* 188 (6), pp.2464-2472.

These publications are frequently cited in other published works, further research, and clinical opinion on the current assessment of LUTS and management of detrusor underactivity. **Paper 3** (cited 43 times) and **Paper 4** (cited 85 times) have both continued to help and inform further research, clinical reviews, and guidelines on men with untreated DUA and BOO. The focus of this work has been particularly useful in helping to identify which men are most likely to respond to surgical intervention, as it is now more widely accepted that men with a BOO and DUA urodynamic diagnosis have less favourable surgical outcomes (Rademakers, van Koeveringe, and Oelke, 2016). This may

mean that for some men with BOO and DUA, surgery would make no difference to their LUTS or provide them with any symptomatic improvement. Thi**s** growing evidence-base continues to inform HCPs which can help them provide up to date knowledge and counselling on individual patient treatment choices in order to provide a fully informed consent process for those who are considering surgical intervention.

The debate on whether or not urodynamics should be offered to men with LUTS prior to surgical intervention has continued to divide professional opinion over the years since this research was undertaken **(Papers 1–2).** Whilst historically HCPs saw UDS as the 'Gold Standard' for the assessment of men with LUTS (Nitti, 2005), others were less convinced of the need for invasive UDS over conventional history taking and examination; this was primarily influenced by the lack of conclusive evidence. Since then, a Cochrane review (Clement *et al*. 2015), found that although UDS can influence decision-making, there was insufficient proof to show that they led improved treatment outcomes. Conversely, a subsequent systematic review of non-invasive tests used in diagnosing BOO in men with LUTS (Malde *et al.* 2017) established that although non-invasive tests have a clear role to play in the assessment of LUTS, and are useful in combination with patient symptom assessment (McCooty, Nightingale, and Latthe, 2018), they are not as accurate at diagnosing BOO. The most recent consensus by leading experts concludes that, despite the lack of high quality evidence, UDS remains the 'Gold Standard' for providing a more accurate diagnosis of BOO (Rademakers *et al.* 2017), and they should still be considered if there is any concern over bladder contractility (Foster *et al.* 2018). These subsequent publications **(Table 4)** highlight the fact that there is still a desire to balance the evidence of benefit with expert opinion. This will also be governed by patient preference for treatment and patient satisfaction post TURP. The overall influence of this body of research will continue to inform patient choice, which will help facilitate the clinical reasoning and decision-making processes of HCPs working with men with LUTS (Drake, 2018). Relating this back to **Papers 1–4**, this evidence also illustrates the accuracy of urodynamic technique in HCPs who have had the appropriate training in the set-up, running, and interpretation of UDS, where the quality of the test and the urodynamic findings can be relied upon with greater confidence.

Table 4: Citations appearing in recent publications relating to urodynamics – current opinion and assessing LUTS, voiding dysfunction, and understanding the impact of detrusor underactivity

- Aggarwal, H., and Zimmern, P.E. (2016) Underactive bladder. *Current Urology Reports.* 17 (3), p.17.
- Andersson, K.E. (2014) Bladder underactivity. *European Urology.* 65 (2), pp.399–401.
- Biardeau, X., Elkoushy, M.A., Aharony, S., Elhilali, M. and Corcos, J. (2016) Is multichannel urodynamic assessment necessary before considering a surgical treatment of BPH? Pros and cons. *World Journal of Urology*. 34 (4) pp.463–469.
- Blaivas, J.G., Forde, J.C., Davila, J.L., Policastro, L., Tyler, M., Aizen, J., Badri, A., Purohit, R.S. and Weiss, J.P. (2017) Surgical treatment of detrusor underactivity: A Short Term Proof of Concept Study. *International Braz J Urol*. 43 (3), pp.540–548.
- Drake, M.J., Williams, J. and Bijos, D.A. (2014) Voiding dysfunction due to detrusor underactivity: an overview. *Nature Reviews Urology.* 11 (8), p.454.
- Drake, M.J. (2018) Is Urodynamics Necessary when Assessing a Patient with Male Lower Urinary Tract Symptoms? *European Urology Focus*. 4 (1) pp.54–56
- Gammie, A., Kaper, M., Steup, A., Yoshida, S., Dorrepaal, C., Kos, T. and Abrams, P. (2018) Signs and symptoms that distinguish detrusor underactivity from mixed detrusor underactivity and bladder outlet obstruction in male patients. *Neurourology and Urodynamics*. 37 (4) pp.1501–1505.
- Gani, J. and Hennessey, D. (2017) The underactive bladder: diagnosis and surgical treatment options. *Translational Andrology and Urology*. 6 (Suppl 2), p.S186.
- Guo, D.P., Comiter, C.V. and Elliott, C.S. (2017) Urodynamics of men with urinary retention. *International Journal of Urology*. 24 (9), pp.703–707.
- Griffiths, D., Abrams, P., D'Ancona, C.A., van Kerrebroeck, P., Nishizawa, O., Nitti, V.W., Tatt, F.K., Tubaro, A., Wein, A.J. and Belal, M. (2008) The urodynamic evaluation of lower urinary tract symptoms in men. *Current Bladder Dysfunction Reports*. 3 (1), pp.49–57.
- Kim, M., Jeong, C.W. and Oh, S.J. (2018) Effect of preoperative urodynamic detrusor underactivity on transurethral surgery for benign prostatic hyperplasia: a systematic review and meta-analysis. *The Journal of Urology*. 199 (1), pp.237–244.
- Lee, S.M. and Hashim, H. (2018) Recent advances in the understanding and management of underactive bladder. *F1000Research*, 7: p.437
- Masumori, N., Furuya, R., Tanaka, Y., Furuya, S., Ogura, H. and Tsukamoto, T. (2010) The 12-year symptomatic outcome of transurethral resection of the prostate for patients with lower urinary tract symptoms suggestive of benign prostatic obstruction compared to the urodynamic findings before surgery. *BJU international*. 105 (10), pp.1429–1433.
- Mayer, E.K., Kroeze, S.G., Chopra, S., Bottle, A. and Patel, A. (2012) Examining the 'gold standard': a comparative critical analysis of three consecutive decades of monopolar transurethral resection of the prostate (TURP) outcomes. *BJU international*. 110 (11), pp.1595–1601.
- Rademakers, K., Drake, M.J., Gammie, A., Djurhuus, J.C., Rosier, P.F., Abrams, P. and Harding, C. (2017) Male bladder outlet obstruction: Time to re-evaluate the definition and reconsider our diagnostic pathway? ICI-RS 2015. *Neurourology and urodynamics*. 36 (4), pp.894-901.
- Rademakers, K.L., van Koeveringe, G.A. and Oelke, M. (2016) Detrusor underactivity in men with

lower urinary tract symptoms/benign prostatic obstruction: characterization and potential impact on indications for surgical treatment of the prostate. *Current Opinion in Urology*. 26 (1), pp.3-10.

- Sung, L.H., Yu, J.H., Chung, J.Y. and Noh, C.H. (2016) Effects of detrusor underactivity on outcome of transurethral resection of the prostate in patients with prostate hyperplasia. *International Journal of Urology*. 23, pp.13-13).

- Van Koeveringe, G.A., Vahabi, B., Andersson, K.E., Kirschner-Herrmans, R. and Oelke, M. (2011) Detrusor underactivity: a plea for new approaches to a common bladder dysfunction. *Neurourology and Urodynamics*. 30 (5), pp.723-728.

- Welk, B., McGarry, P., Baverstock, R., Carlson, K. and Hickling, D. (2018) Do Urodynamic Findings Other Than Outlet Obstruction Influence the Decision to Perform a Transurethral Resection of Prostate?. Urology. 117 p120-125

The fifth most cited paper – **Paper 7** (28 citations) has influenced further research in women with overactive bladder **(Table 5)**. One of the most critical findings from this research was that once there had been a urodynamic diagnosis of detrusor overactivity, there is little chance of any recovery from this symptom complex of increased daytime frequency, urgency (with or without urgency incontinence), and nocturia. With this increasing awareness and ensuing publications, there was greater recognition of the severity of OAB symptoms in some women, which is effectively a chronic long-term condition. This is where urodynamics have remained a useful tool in the assessment, diagnosis, and management of OAB when conservative or medical management has failed to improve symptoms (Wyndaele and Abrams, 2018). Understanding the 'natural history' of detrusor overactivity, and any related underlying pathophysiology, has also been significant in selecting the choice of therapies that may be suitable for those with refractory symptoms following urodynamic diagnosis (Wallace and Drake, 2015). Therefore, the urodynamic assessment of women with OAB symptoms is only recommended if they have failed conservative management and pharmacological treatment (NICE, 2013). Following the impact of this research **(Paper 7)** has also revealed its influence on understanding the longer-term effect on women's quality of life, which has helped to inform a greater understanding of patients' expectations of their management and treatment options (Rantell, Cardozo, and Khullar, 2017). This approach to future research will undoubtedly help HCPs cultivate a partnership approach to working with women with OAB, which will support the development of coping strategies/self-help for women living with a diagnosis of detrusor overactivity.

Table 5: Citations appearing in publications relating to the overactive bladder in women – assessment, diagnosis and management

- Allahdin, S. and Oo, N. (2012) An overview of treatment of overactive bladder syndrome in women. *Journal of Obstetrics and Gynaecology*. 32(3) pp.217-221.
- Heidler, S., Mert, C., Temml, C. and Madersbacher, S. (2011) The natural history of the overactive bladder syndrome in females: a long-term analysis of a health screening project. *Neurourology and urodynamics*. 30 (8) pp.1437-1441.
- Jeong, S.J., Lee, S.C., Jeong, C.W., Hong, S.K., Byun, S.S. and Lee, S.E. (2013) Clinical and urodynamic differences among women with overactive bladder according to the presence of detrusor overactivity. *International Urogynecology Journal*. 24 (2) pp.255-261.
- Krhut, J., Martan, A., Zachoval, R., Hanus, T., Horcicka, L., Svabík, K. and Zvara, P. (2018) Is it possible to cure the symptoms of the overactive bladder in women? *International urology and nephrology*. 50 (3) pp.433-439.
- Rantell, A. (2013) Assessment and diagnosis of overactive bladder in women. *Nursing Standard*. 27 (52).
- Rantell, A. (2014) Pharmacological management of overactive bladder in women. *Nurse Prescribing*. 12 (5) pp.232-236.
- Rantell, A., Cardozo, L. and Khullar, V. (2017) Personal goals and expectations of OAB patients in the UK. *Neurourology and Urodynamics*. 36 (4) pp.1194-1200.
- Tarcan, T., Rademakers, K., Arlandis, S., von Gontard, A., van Koeveringe, G.A. and Abrams, P. (2018) Do the definitions of the underactive bladder and detrusor underactivity help in managing patients: International Consultation on Incontinence Research Society (ICI-RS) Think Tank 2017? *Neurourology and Urodynamics* 37 (S4), pp.S60-S68.
- Valentini, F.A., Marti, B.G., Robain, G. and Nelson, P.P. (2011) Phasic or terminal detrusor overactivity in women: age, urodynamic findings and sphincter behavior relationships. *International Braz J Urol*. 37 (6) pp.773-780.

Paper 6 was the sixth most cited paper (16 citations), which has led to subsequent publications and recommendations for UDS **(Table 6)**. Whereas **Papers 1–5** have informed knowledge and understanding of the role of UDS in the assessment of lower urinary tract dysfunction, **Paper 6** influenced the understanding of the role of education and training in UDS and identified how this can impact the reliability and reproducibility of UDS. It was reassuring to review these later publications, as it became clear that the authors have continued to look at the requirements of urodynamic training in relation to their reliability and diagnostic performance, as well as the importance of good practice guidelines and standardisation documents (Singh *et al.* 2010). Although I was aware of many of these publications and related citations, this critical appraisal of published work confirmed my contribution to the evidence base. Likewise, there has been further

analysis of quality control and the underpinning evidence for urodynamic practice. This regular review of new evidence, and contribution from experts, can only help to raise the profile of good urodynamic practice (Rosier, 2013); this will hopefully encourage greater adherence to ICS standards in the assessment of patients with LUTS (Rosier *et al.* 2016). With clear direction and guidance within professional bodies (e.g. BAUS, BAUN) there is now a continuous drive for improvement in the assessment of LUTD, which can only serve to inform and support HCPs in their specialist urodynamic training and on-going professional development (Drake and Abrams, 2018). This sentiment has also been translated into the recent guidance 'Excellence in Continence Care' (NHS England, 2018), which highlights the need for specialist diagnostics in patient assessment, undertaken by staff who have the relevant training and expertise.

Table 6: Citations appearing in publications relating to urodynamic training and education

- Hogan, S., Jarvis, P., Gammie, A. and Abrams, P. (2011) Quality control in urodynamics and the role of software support in the QC procedure. *Neurourology and urodynamics*. 30 (8) pp.1557-1564.
- Newman, D.K., Ee, C.H., Gordon, D., Srini, V.S., Williams, K., Cahill, B. and Norton, N. (2009) Continence promotion, education & primary prevention. *Incontinence, Proceedings from the 4th International Consultation on Incontinence.* Plymouth, UK: Health Publication. pp.1643-84.
- Renganathan, A., Cartwright, R., Cardozo, L., Robinson, D. and Srikrishna, S. (2009) Quality control in urodynamics: Analysis of an international multi-center study. *Neurourology and Urodynamics: Official Journal of the International Continence Society*. 28 (5) pp.380-384.
- Rosier, P.F., GaJewski, J.B., Sand, P.K., Szabó, L., Capewell, A. and Hosker, G.L. (2010) Executive summary: The International Consultation on Incontinence 2008—Committee on: "Dynamic Testing"; for urinary incontinence and for fecal incontinence. Part 1: innovations in urodynamic techniques and urodynamic testing for signs and symptoms of urinary incontinence in female patients. *Neurourology and Urodynamics: Official Journal of the International Continence Society*. 29(1), pp.140-145.
- Rosier, P.F. (2013) The evidence for urodynamic investigation of patients with symptoms of urinary incontinence. *F1000 prime reports*. 5.
- Sekido, N. (2012) Bladder contractility and urethral resistance relation: what does a pressure flow study tell us? *International Journal of Urology*. 19 (3) pp.216-228.
- Shamout, S., Andonian, S., Kabbara, H., Corcos, J. and Campeau, L. (2018) Teaching and evaluation of basic urodynamic skills in urology residency programs: Randomized controlled study. *Neurourology and Urodynamics*. 37 (8) pp.2724-2731
- Townsend, J. (2015) Developing a nurse-led urodynamics clinic. *International Journal of Urological Nursing*. 9 (3) pp.173-176.
- Yamanishi, T., Sakakibara, R., Uchiyama, T. and Hirata, K. (2011) Role of urodynamic studies in the

Papers 5, 8, 9, and 10 have collectively received 20 citations – of the 10 published papers, these were the ones that I would consider to be more 'niche' in nature. **Paper 5** focused on the 'area under the curve' (in children), which was an emerging area of research to help in the prediction of raised intravesical bladder pressure, and this remains an area of interest and research in adults with neurogenic bladder dysfunction (Hidas *et al.* 2017). Whilst **Paper 8** was a proof of concept study using a selective α1-adrenergic receptor agonist (phenylephrine/PSD503), this pharmacotherapy has not undergone further clinical trials in stress urinary incontinence. The focus of **Papers 9** and **10** gave further perspective on the challenges that HCPs face in their urodynamic practice, as well as useful evidence on the use of air-filled pressure measurement catheters in UDS. The number of citations (505) of my published work helps to validate my research impact and highlights the new knowledge that was generated by this work; also illustrating the way this evidence has been translated into practice guidelines and subsequent research.

Appreciating contemporary approaches to knowledge mobilisation

There are a range of different terms used in the mobilisation of research – knowledge translation, research knowledge exchange (RKE), and knowledge transfer; recent literature suggests that 'knowledge mobilisation' is a useful umbrella term to capture the range of research activities involved in the dissemination of research findings (Lightowler, Stocks-Rankin, and Wilkinson, 2018). The significance and role of KM, in this context, became more evident as I started to reassess the impact of my research portfolio. In retrospect, I can see that I have adopted a reflexive approach to using KM in my teaching, and as previously mentioned (p. 40) my 'split' role meant that my research knowledge has informed my practice, and vice-versa. Essentially I have used the opportunities presented to me, such as educational courses or conferences, to highlight the latest evidence and publications as a way of encouraging HCPs to engage with RKE from the researchers' perspective (Pentland *et al.* 2011). Some of my research outputs have also led to poster presentations at national and international conferences **(Table 7)**, where collaborative working and participation in these environments can positively influence change or review of professional practice (Gagliardi *et al.* 2015).

Table 7: Conference Abstracts – Poster Presentations

- **Ellis-Jones, J**. Swithinbank, L. Abrams, P. (2003) "Does urodynamic training have an impact on clinical practice?" 33rd International Continence Society Annual Conference, Florence, Italy. October.
- **Ellis-Jones, J**. Bevan, W. Matharu, G. Assassa, P, Abrams, P. (2006) "Quality control: A comparison of urodynamic traces before and after attendance at an established urodynamic course." 36th International Continence Society Annual Conference, Christchurch, New Zealand. November.
- Belal, M., **Ellis-Jones, J**. and Abrams, P. (2006) "The origin of the penile compression release index-A video urodynamic analysis." 36th International Continence Society Annual Conference, Christchurch, New Zealand. November.
- **Ellis-Jones, J.** Swithinbank, L. Abrams, P. (2008) "The Application and Interpretation of ICS Urodynamic Practice Guidelines: A Regional Perspective (Part 1)." 15th United Kingdom Continence Society Annual Scientific Meeting, Basingstoke, UK. April.
- **Ellis-Jones, J.** Swithinbank, L. Abrams, P. (2008) "The Bridges and Barriers to 'Good' Urodynamic Practice: A Regional Perspective (Part 2)." 15th United Kingdom Continence Society Annual Scientific Meeting, Basingstoke, UK. April.
- **Ellis-Jones, J.** Swithinbank, L. Abrams, P. (2008) "The Application and Interpretation of International Standardisation Reports – The Bridges and Barriers to 'Good' Urodynamic Practice: A Regional Perspective." 38th International Continence Society Annual Conference, Cairo, Egypt. October.
- **Ellis-Jones, J.** Swithinbank, L. (2011) UKCS Membership Training and Education Survey (Urodynamics). United Kingdom Continence Society 18th Annual Scientific Meeting, Bristol, UK. April.
- Williams, J.P., Bevan, W., **Ellis-Jones, J**. and Hashim, H (2014) Ambulatory urodynamics in clinical practice: A single centre experience. *European Urology Supplements*, *13* (1), Published Abstract: 387. 29th Annual Congress, Stockholm, Sweden. April.
- Mitchell, M., **Ellis-Jones, J.** (2016) Evaluation of an innovative partnership model for preparing mentors. (FLAP Project). Nurse Education Today Annual Conference, Cambridge, UK. Sept.

As I began to develop my existing research networks I received invitations to speak on aspects of research protocol design (bladder diary training) at international clinical trial investigator meetings over the same time period. My experience in this setting was particularly useful, as I could explain the data collection methods from a clinical research nurse perspective, to emphasize the importance of patient training (training the trainer), which would support both the accuracy and reliability of patient symptom scoring and urinary measurements within the clinical trial **(Table 8)**. This activity also mirrors the philosophy and subsequent growth (since 2013) of the Academic Health Science Networks (AHSNs) in the UK, which have linked the clinical/research expertise of the NHS, academic institutions, local authorities, the third sector and industry (The AHSN Network,

2018). The sole purpose of these networks is to help improve patient outcomes through the sharing of best practice ideas, research and innovation; however their impact on KM is still under review and requires further evaluation, but the principle of AHSNs is promising (Ferlie *et al.* 2017).

Table 8: Invited Speaker – Clinical Trial Meetings

- Ellis-Jones, J (2006) – Bladder diary training [lecture and workshop at the Pfizer International Investigator meeting], Budapest, Hungary. 20-22nd January.
- Ellis-Jones, J (2009) – Bladder diary training [lecture and workshop at the Ono Pharma 1st International Investigator 'Emerald Study' meeting], Prague, Czech Republic. 3-5th June.
- Ellis-Jones, J (2009) – Bladder diary training [lecture and workshop at the Ono Pharma 2nd International Investigator 'Emerald Study' meeting], Paris, France. June.

I became involved in the development, design, and provision of educational workshops for national and international conferences **(Table 9)**. I have included these as they highlight how my combined clinical/research role has helped translate research and exchange knowledge with other HCPs worldwide. New researchers, who will use urodynamic skills in their research, will also attend urodynamic training at conferences. This academic engagement is akin with both the principles of KM and GCP in clinical research. Similarly, Curtis *et al.* (2016), and the recent National Institute for Health Research (NIHR, 2017) strategy for clinical research nursing (2017-2020), have emphasised the need for clear translation of research evidence; achieving this could also be supported by the parallel drive to develop academic careers in nursing within the UK (Gerrish and Chapman, 2017). Essentially, these recent publications acknowledge that nurse researchers play a significant role in research knowledge exchange (RKE), in addition to their ability to facilitate a culture of evidence-based practice in all aspects of healthcare.

Table 9: Individual contribution to study days, national standards, and national and international conferences

- 2008: Involvement with UKCS UDS working party/standards/RCN.
  This led to the publication of United Kingdom Continence Society (2009) Joint statement on minimum standards for urodynamic practice in the UK: A report of the urodynamic training and accreditation steering group.
- **Ellis-Jones, J.** (2009) The role of the clinical research nurse in commercial trials, United Kingdom Continence Society 16th Annual Scientific Meeting, Swansea, UK. April.

- **Ellis-Jones, J.** (2009) "Work-based Learning: A student's journey to enlightenment and higher academic achievement." UALL Work Based Learning Network Conference – UWE, Bristol. July.
- 2010 – 2011: Invited to be an organisation committee member for the UKCS Annual Scientific Meeting and Conference. UKCS, Bristol, April.
- Drake, M., **Ellis-Jones, J.,** Gammie, A., Swithinbank, L. (2009) Educational workshops – urodynamic 'hands on training' workshop tutor. 39th International Continence Society Annual Conference, October. San Francisco, USA. September.
- Drake, M., **Ellis-Jones, J.,** Gammie, A., Swithinbank, L. (2011) Educational workshops – urodynamic 'hands on training' workshop tutor. 41st International Continence Society Annual Conference, October, Glasgow, UK. August.
- Drake, M., **Ellis-Jones, J.,** Gammie, A., Hashim, H. (2012) Educational workshops – urodynamic 'hands on training' workshop tutor. 42nd International Continence Society Annual Conference, Beijing, China. October.
- **Ellis-Jones, J. (2012)** Demystifying clinical evidence – using a recent publication as a case study: Presentation and workshop. Wellspect Study Day for Continence Nurses, Stroud, UK. March.
- **Ellis-Jones, J.,** Gammie, A., Hashim, H. (2013) Urodynamic Workshop. British Association of Urology Nurses Conference, Harrogate, UK. November.
- **Ellis-Jones, J.,** Gammie, A., Belal, M. (2015) Urodynamic Workshop. British Association of Urology Nurses Conference. Brighton, UK. November.
- Drake, M., **Ellis-Jones, J.,** Gammie, A., Hashim, H. (2013) 28th Annual European Association of Urologists. ESU Hands-on training in Urodynamics. Milan, Italy.
- Drake, M., **Ellis-Jones, J.,** Gammie, A., Hashim, H. (2014) 29th Annual European Association of Urologists. ESU Hands-on training in Urodynamics. Stockholm, Sweden.
- Drake, M., **Ellis-Jones, J.,** Gammie, A., Hashim, H., Thomas, L. (2015) 30th Annual European Association of Urologists. ESU Hands-on training in Urodynamics. Madrid, Spain
- **Ellis-Jones, J.** (2017) The overactive bladder in women – symptom presentation, assessment and ongoing management. British Association of Urological Nurses Study Day, Bristol, UK. March.

I also had the opportunity to work on other collaborative research studies and service evaluation projects with industry, other academic institutions and third sector organisations, where I have been able to utilize my skills in the design, coordination, and methods for data collection and analysis **(Table 10)**. Since 2013, I have also translated this knowledge and expertise into providing academic supervision for BSc and MSc dissertation students at UWE. Latterly, this combined experience as a nurse researcher and academic has resulted in my appointment to the scientific congress office for the European Association of Urological Nurses (EAUN) for a three-year term, which started in April 2018. This position will continue to nurture my research interests, allow me to support new and emerging researchers, and provide peer and scholarly review at an international level.

Table 10: Research Collaboration Projects

- **2010 – 2012**
  I was seconded from the BUI to work on a two-year research contract with the University of Bristol, working with Professor Jenny Donovan and Dr Sarah Brookes for 1 day/per week. This was a follow-up study to the CLasP study (Donovan *et al.* 2000) and I was the Lead Research Nurse and study site co-coordinator for Bristol and Newcastle and Sunderland, where I was also responsible for conducting patient interviews, data collection/management, and data analysis.

- **2009 – 2010**
  Nurse consultancy (Ono Pharma): Research Nurse Advisor/Clinical Trial and Protocol Development

- **2014 – 2015**
  Nurse consultancy (Astellas): Protocol Committee Steering Group (External Nurse Advisor)

- **2014 – Present**
  UWE Nursing and Midwifery – Service Evaluation Team Projects:
    - Facilitating Learning and Assessment in Practice (FLAP) Evaluation of the FLAP Project. Responsible for data collection, conducting focus group/interviews, data analysis, report writing.
    - Don't Wait to Anticoagulate Project Evaluation (DWAC). Responsible for data collection, semi-structured interviews, data analysis, report writing (Moule *et al.* 2018)
    - 1626ip Project. Responsible for data collection, conducting semi-structured interviews/focus groups, data analysis, report writing.

Looking forward – ways of sustaining and developing research impact

The last 10 years has also seen the rise and use of social networks for researchers and HCPs (Barton and Merolli, 2017). An example is ResearchGate (RG), has allowed me to share/discuss research papers with other researchers, as well as providing another platform to raise the profile of my research. This has been beneficial to me as I receive regular email updates, metrics, and citation alerts on all my publications. RG also provides the number of reads, which gives another indicator of my research impact and knowledge mobilisation. Similarly, LinkedIn has been a useful social network to engage with partners and colleagues working in industry and other professional roles. Arguably, social media and online resources have greatly transformed the ways in which knowledge is now shared (Stawicki *et al.* 2018). Increasingly, this can lead to even greater opportunities for knowledge mobilisation and translation of evidence into practice.

In summary, this section illustrates the impact of my research outputs within the context of other contemporaneous research, which clearly demonstrates how I have mobilised this knowledge through academic engagement, professional networks, and partnership working with industry. This exposure led to further involvement with educational directives and subsequent research collaborations.

Conclusion and Implications for Practice

This critical commentary, based on a portfolio of published work, has been submitted in partial fulfillment of the requirements of the University of the West of England, Bristol for Doctor of Philosophy by publication (DPhil). Throughout this body of work I have endeavoured to create a coherent narrative that explores critically the relationship between the published work submitted and the current body of knowledge in the field. This not only illustrates my journey of academic enquiry, but also shows how advanced scholarship has been achieved through the synthesis of selected original research. This collection shows a deeper understanding of urodynamics in the context of clinical research and their role in the assessment of lower urinary tract dysfunction. The retrospective approach used has not only acknowledged the interrelated role of the nurse researcher, but clearly demonstrates aspects of originality, significance and rigour throughout the research. The subsequent analysis identified themes, which represent my research development in three distinct phases: learning how to be a researcher (the early years), nursing leadership in research (the middle years), and advancing practice through the translation of research into practice (the later years).

The ability to reflect on this experience helped me appreciate how I have developed a depth of understanding, and insights, in relation to ontological and epistemological positions in research. This was another useful endorsement, and where I was able finally to acknowledge the scope of my original scholarly contribution to research, and the associated development of new knowledge. This gave me further opportunity to assess the full extent of my research impact, and consider this within the context of past and present practice, as well as the implications this may hold for future practice. I will continue to take the opportunities presented to me, mobilising new and existing knowledge through academic engagement, and developing professional networks and partnership working with industry. To conclude, I believe I have made a unique contribution to the urological research cited.

"Let whoever is in charge keep this simple question in her head (not, how can I always do this right thing myself, but) how can I provide for this right thing always to be done?"

—Florence Nightingale, (1860)

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GLOSSARY

AFC	Air filled catheter
AHSN	Academic Health Science Networks
BAUN	British Association of Urological Nurses
BAUS	British Association of Urological Surgeons
BOO	Bladder outlet obstruction
BSc	Bachelor of Science
BUI	Bristol Urological Institute
CNS	Clinical nurse specialist
CRF	Case report form
DoH	Department of Health
DO	Detrusor overactivity
DOI	Detrusor overactivity incontinence
DPhil	Doctor of Philosophy
DUA	Detrusor underactivity
EAU	European Association of Urology
EAUN	European Association of Urology Nurses
EU	European Union
GCP	Good clinical practice
GP	General practitioner
GUP	Good urodynamic practice
HCP	Health care professional
ICH	International Council for Harmonisation
ICS	International Continence Society
IDO	Idiopathic detrusor overactivity
KM	Knowledge mobilisation
LUTD	Lower urinary tract dysfunction
LUTS	Lower urinary tract symptoms
MSc	Master of Science
MUI	Mixed urinary incontinence
NICE	The National Institute for Health and Care Excellence
NIHR	The National Institute for Health Research
NBT	North Bristol (NHS) Trust
NHS	National Health Service
OAB	Overactive bladder
PIS	Patient information sheet
RCT	Randomised controlled trial
REC	Research ethics committee
REF	Research Excellence Framework
RI	Research impact
RKE	Research knowledge exchange
SUI	Stress urinary incontinence
TURP	Transurethral resection of prostate
UDS	Urodynamics
UK	United Kingdom
UKCS	United Kingdom Continence Society
USA	United States of America
USI	Urodynamic stress incontinence
UWE	University of the West of England
VAS	Visual analogue scale
WFC	Water filled catheter

Appendix One – Co-author Testimonials

Co-author confirmation and supporting Statement for Julie Ellis-Jones, 2nd April 2018

I have known Julie Ellis-Jones since 1997 when she came to work in the urodynamic unit at Southmead Hospital, North Bristol Trust. She became clinical nurse specialist and senior research nurse in the Bristol Urological Institute before taking up her academic post at UWE in 2013.

During her time with us she supported and led developments in both the clinical, teaching and research elements of our work. She introduced nurse-led urodynamic clinics and started the sacral nerve stimulation service with Mr Hashim (Urology Consultant) for urology patients in Bristol and the South West region.

She was a course tutor for the Bristol Urological Institute 'Basic Urodynamic Course', 'Certificate in Urodynamics' (2000–2014), and still teaches on the 'Expert in Urodynamics Course' (2013–present). She has also taught at the annual conferences of the International Continence Society, British Association of Urological Nurses, and the European Association of Urology. She is now a member of the scientific congress office for the European Association of Urology Nurses, 2018–2021.

Julie has made a great contribution to urological research. She was responsible for setting up urodynamic research clinics, care of patients, running and interpreting UDS investigations, and collecting/storing data for the research studies. This led to her research with two fellows, Alun Thomas and Steve Garnett, resulted in a series of five seminal papers that remain the most important long-term natural history publications describing the progress of men with lower urinary tract symptoms and women with overactive bladder and detrusor overactivity. She has also researched and published on other aspects of urodynamics as well as urodynamic investigation standards, and remains active in this area.

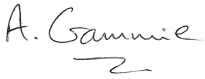
In view of her considerable contributions to research, teaching and clinical developments in urology, I am delighted to provide this supporting statement for Julie Ellis-Jones.

Paul Abrams
Professor of Urology, University of Bristol
Head of Teaching and Research, Bristol Urological Institute
Chair of Trustees, North Bristol Trust Research Foundation
Secretary, International Consultation on Urological Diseases

Co-author confirmation
– Prof. Hashim Hashim, Consultant Urological Surgeon & Honorary Professor of Urology

Publications in chronological order:	**Declaration of Authorship**
5. Hashim, H., Ellis-Jones, J., Swithinbank, L., Woodward, M., Small, D., Frank, J. and Abrams, P (2005) Trying to predict 'dangerous' bladders in children: The area under the curve concept. *Journal of Paediatric Urology.* 1 (5), pp.343–347	Co-author: I was approached by H. Hashim to undertake a retrospective review, and interpretation of paediatric urodynamic investigations. Manual urodynamic trace analysis. (Quantitative Methods)
11. Ellis-Jones, J., and Hashim, H., (2017) Urodynamics. In: Hamdy, F., Eardley, I., ed., (2017) *Oxford Textbook of Urological Surgery*. Oxford: Oxford University Press, pp.230–244	Co-author with H. Hashim. We were approached by OUP and asked to write a chapter on Urodynamics for this reference textbook.
Author confirmation statement: I confirm that the declaration of authorship, for the above publications 5 and 11, reflect the original research contribution of Julie Ellis-Jones to our co-authored work.	 **Signature:** **Date:** 2018-08-10

Co-author confirmation – Mr Andrew Gammie, Clinical Scientist

Publications in chronological order	**Declaration of Authorship**
10. Gammie, A., Abrams, P., Bevan, B., Ellis-Jones, J., Gray, J., Hassine, A., Williams, J. and Hashim, H. (2015) Simultaneous in vivo comparison of water-filled and air-filled pressure measurement catheters: Implications for good urodynamic practice. *Neurourology and Urodynamics* 35 (2) 1 – 8	Co-author: Informed consent process, and consenting participants. Setting up the research clinics, collecting and recording urodynamic investigations/data collector, analysis and interpretation of data, electronic capture and storage of data. (Quantitative Methods)
Author confirmation statement: I confirm that the declaration of authorship, for the above publication (10), reflect the original research contribution of Julie Ellis-Jones to our co-authored work.	**Signature:**  **Date: 10th August 2018**

Appendix Two: PGR2.2 UWE Doctoral Descriptors

PGR2.2.1R

The award of a doctorate of the University requires the postgraduate researcher to demonstrate that they:

a. have conducted enquiry leading to the creation and interpretation of new knowledge through original research or other advanced scholarship, shown by satisfying scholarly review by accomplished and recognised scholars in the field;

b. can demonstrate a critical understanding of the current state of knowledge in that field of theory and/or practice;

c. show the ability to conceptualise, design and implement a project for the generation of new knowledge at the forefront of the discipline or field of practice including the capacity to adjust the project design in the light of emergent issues and understandings;

d. can demonstrate a critical understanding of the methodology of enquiry;

e. have developed independent judgement of issues and ideas in the field of research and / or practice and are able to communicate and justify that judgement to appropriate audiences;

f. can critically reflect on their work and evaluate its strengths and weaknesses including understanding validation procedures.

Appendix 3 – Individual citations (Google Scholar™)

Publication Title	Cited by other authors
1. Thomas, A., Cannon, A., Bartlett, E., Ellis-Jones, J. and Abrams, P. (2004) The natural history of lower urinary tract dysfunction in men: the influence of detrusor underactivity on the outcome after transurethral resection of the prostate with a minimum 10-year urodynamic follow-up. *BJU International.* 92 (6), pp.745–50	170
2. Thomas, A., Cannon, A., Bartlett, E., Ellis-Jones, J. and Abrams, P. (2005) The natural history of lower urinary tract dysfunction in men: minimum 10-year urodynamic follow-up of transurethral resection of prostate for bladder outlet obstruction. *Journal of Urology.* 174 (5), pp.1887–91	143
3. Thomas, A., Cannon, A., Bartlett, E., Ellis-Jones, J. and Abrams, P. (2005) The natural history of lower urinary tract dysfunction in men: minimum 10-year urodynamic follow-up of untreated detrusor underactivity. *BJU International.l* 96 (9), pp.1295–300	43
4. Thomas, A., Cannon, A., Bartlett, E., Ellis-Jones, J. and Abrams, P. (2005) The natural history of lower urinary tract dysfunction in men: minimum 10-year urodynamic follow-up of untreated bladder outlet obstruction. BJU *International.* 96 (9), pp.1301–6	85
5. Hashim, H., Ellis-Jones, J., Swithinbank, L., Woodward, M., Small, D., Frank, J. and Abrams, P. (2005) Trying to predict 'dangerous' bladders in children: The area under the curve concept. *Journal of Paediatric Urology.* 1 (5), pp.343–347	1
6. Ellis-Jones, J., Swithinbank, L., and Abrams, P. (2006) The impact of formal education and training on urodynamic practice in the UK: A survey. *Neurourology & Urodynamics.* 25 (5), pp.406–410	16
7. Garnett, S., Swithinbank, L., Ellis-Jones, J. and Abrams, P. (2009) The long-term natural history of overactive bladder symptoms due to idiopathic detrusor overactivity in women. *BJU International.* 104 (7), pp.948-953	28
8. Robinson, D., Abrams, P., Cardozo, L., Ellis-Jones, J., Heath, P. and Wyllie, M. (2011) The efficacy and safety of PSD503 (phenylephrine 20%, w/w) for topical application in women with stress urinary incontinence. A phase II, multicentre, double blind, placebo controlled, 2-way cross over study. *European journal of obstetrics, gynaecology, and reproductive biology.* 159 (2), pp.457–460	8
9. **Ellis-Jones, J., Swithinbank, L. and Abrams, P (2013)** The bridges and barriers to 'good' urodynamic practice: a regional perspective. *International Journal of Urological Nursing.* 7 (1), pp3-8	2
10. Gammie, A., Abrams, P., Bevan, W., Ellis-Jones, J., Gray, J., Hassine, A., Williams, J. and Hashim, H. (2015) Simultaneous in vivo comparison of water-filled and air-filled pressure measurement catheters: Implications for good urodynamic practice. *Neurourology and Urodynamics.* 35 (2), pp.1–8	9