Evaluating nursing opinion and perception of Maggot Therapy for chronic wound management

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Abstract

Background

Maggot Therapy (MT) or Larval Debridement Therapy is a recognised and effective treatment for the management of chronic and infected ulcers. It is available on NHS prescription in the UK where wound management is predominantly nurse-led. Anecdotal reports and published literature, however, suggests that nurses may be reluctant to utilise the therapy. The aim of this study was to evaluate the feelings and opinions of nurses regarding the use of MT.

Methods

The first stage of this mixed methods study was a focus group held to discuss MT and opinions of specialist nurse clinicians. Next, an anonymised web-based online survey was launched through the Nursing Times journal and distributed through social media targeting all nurses. Finally, in depth interviews were held with specialist and generalist nurses.

Results

Results indicated that awareness of MT amongst nurses was extremely high. A breakdown of results, however, showed that MT was much more highly regarded by wound specialist nurses than non-wound specialist nurses. The latter exhibited a greater level of reluctance to administer the therapy, with almost one third of these nurses surveyed saying they found maggots disgusting. In depth interviews revealed that a lack of knowledge about MT was a prime concern, and there was a need to address this.

Conclusions

Wound specialist nurses are more likely to embrace MT than non-wound nurse specialists, who report a varying degree of wariness to MT. Our study highlights a need for better education and training in MT for all nurses, to address issues with acceptance and willingness to treat or help treat patients with chronic wounds which are suitable for MT.

Introduction

Chronic wounds, such as leg ulcers, diabetic foot ulcers and pressure ulcers, are managed by healthcare practitioners and wound clincians, and in the UK, wound care is predominantly nurse-led. Many treatments exist to help manage chronic wounds, and one such treatment is Maggot Therapy (MT), the application of clinical grade, sterile, living maggots onto a necrotic and infected wound.

Maggot therapy

Medicinal maggots (*Lucilia sericata*), are specially reared germ-free, baby stages of the greenbottle fly, which can be applied to the wound for 3-4 days, either free on the wound contained in taped dressings, or within sealed, net Biobags. In the UK, MT or Larval Debridement Therapy (LTD), has been available on NHS prescription since 2004. Maggots work to primarily debride (rid) wounds of dead, necrotic tissue (Atkin et al, 2020; Greene et al, 2021), but several scientific studies also show that they exhibit effective disinfection properties (Van der Plas et al, 2010; Poppel et al., 2015; Polat et al, 2020), and are able to promote wound healing (Maeda et al 2014; Wang et al, 2020; Gazi et al, 2021). There is abundant clinical evidence, including randomised controlled trials (Dumville et al, 2009a; Mudge et al, 2014), which support the use of MT in chronic wound debridement, and, studies have also been undertaken to show its efficacy and cost-effectiveness (Wayman et al, 2000; Bennet et al, 2013).

The Yuck factor

Despite mounting clinical and scientific evidence, there appears to be a general dislike and public reluctance surrounding maggot use (the Yuck factor), with only

36% of recently surveyed members of public saying that they would be willing to give MT a try (Nigam et al, *In Press*). Nurses, in particular Tissue Viability Nurses, District and Community Nurses, tend to lead chronic wound care in the UK and thus their perceptions and opinions of MT are extremely important.

Historically, MT was used extensively in hospitals in America and Canada in the pre-antibiotic era of the 1930s. Literature suggests that the issue of clinicians' disgust regarding MT was a considerable obstacle then. Some clinicians refused altogether to consider its use (Wainwright, 1988). It was also known that a patient's level of comfort with MT closely mirrored that of his/her doctor's own comfort with the procedure (Bethune, 1936). Where clinicians themselves felt disgust, patients would echo this sentiment. Overcoming disgust among practitioners as much as patients was therefore a great challenge in 1930s USA. In a more recent and detailed study, nurse clinicians agreed that they felt the way in which they broached the subject of MT with their patients could influence decisions as to whether the patient decided to accept or reject the treatment (Dumville et al, 2009b). Nonetheless, results of another survey discovered that health care professionals and administrators were much more likely to be disgusted by the thought of maggot dressings than their patients (Sherman et al, 2007).

The aim of our current study was to evaluate the current perceptions, opinions and usage of maggot therapy amongst the nursing profession.

Methodology

Research Design

This study utilised a mixed-method approach to obtain quantitative and qualitative data on nurse's perceptions and opinions of MT. The design consisted of three consecutive stages: 1) a focus group to establish initial perceptions, 2) a national, online survey to explore these perceptions more widely; and 3) and in depth semi-structured interviews to explore lived experiences of MT.

Stage 1) Focus group

A focus group was held with five wound specialist nurses (all were senior Tissue Viability Nurses, and all had prior experience of using MT). Participants were asked about their general attitudes and opinions towards MT, and those of their colleagues. The discussion was guided by three key themes:

a) Acceptance and perception of MT by nursing staff

b) Knowledge of MT within the nursing profession

c) Barriers or hurdles associated with MT.

The focus group lasted an hour and field notes were taken and analysed to inform the design of the survey used in the next stage of the research A graphic record of the focus group discussion was also captured (see Nigam et al., in press).

Stage 2) Online Survey

An anonymous, cross-sectional online survey was prepared to further investigate the key emergent themes from the focus group. This was conducted between November 2017 – February 2018. The peer-reviewed UK and International Journal, Nursing

Times, agreed to host and advertise the survey and participants were recruited to the study through this. Participants were asked to indicate their position and role within the nursing profession. Based on this information, participant responses were categorised into two groups: those having received some training in wound management (designated as “wound specialist” nurses (WS) e.g. Tissue Viability, Practice, District and Community Nurses) and those who had no specialist knowledge of wound care (designated as “non-wound specialist” nurses (NWS) e.g. staff nurses, registered general nurses, student and other). Additional demographic data were collected to measure gender, age, geographical location, and prior personal experience of MT.

Responses to statements seeking participant opinion on usage and perceptions of MT were offered on a 5-point Likert scale (Strongly agree, agree, neither agree nor disagree, disagree and strongly disagree).

In addition, participants were also asked if they agreed or disagreed with a series of perceived barriers, such as cost or issues with ordering. Finally, (through open-ended responses), participants were asked to independently identify any other issues associated with MT.

Stage 3) In-depth, one-one interviews

This final part of the study was carried out between March 2018 – January 2020 and followed a phenomenological methodology. In order to understand the essence of nurse’s perceptions of maggot therapy, questions on their historical ‘lived experience’ were asked. This aligned with phenomenology in its purest sense, i.e. the interpretation of nurse’s experience of maggot therapy is retrospective (Patton, 2002; Van Manen, 1990). However, as prospective questions on how the ‘Yuck’

factor can be challenged and maggot therapy be made more mainstream in wound debridement were asked, this research was attempting to illicit nurses' perceptions on future 'possibilities'. As humans, nurses have an abstract model of the world which causes them to create a theory about their engagement and relationship with the use of maggots in wound debridement. However, feeding into whether they will engage with this therapy is their historical past perceptions of maggots, their present knowledge, and the future needs and use of maggots in professional practice. As the nurse participants were continually reflecting and reinterpreting these constructs, there is a continuous remaking of meanings between their understanding of maggot therapy as a 'whole' and engagement with the phenomenon as a 'part' of their life. Figure 1 illustrates this reflective process.

Therefore, in order to address the research aim, the theoretical constructs of the hermeneutic circle (Crotty, 1998; Ransome, 2010; Van Manen, 1990), were employed as this interpretive approach accommodated the forward and backwards elucidation of the nurse's narrative.

THEORETICAL FRAMEWORK

Originally postulated to explain how technological adoption filters through society, the Diffusion of Innovation Theory is seen as a useful tool to conceptualise adoption of technologies in a wide arena of disciplines such as communication technologies (Sahin, 2006), the medical profession (Bhattacharya & Singh, 2019); pharmacy (Makowsky et al, 2013); and geriatrics (Olsson et al., 2016).

The bell-shaped diagram in figure 2 illustrates the five categories of technology adoption. Innovators may be described as 'technology enthusiast'; they are the gatekeepers for the next group of adopters (Kaminski, 2011). The early adopters are visionaries and enthusiasts who want to revolutionise the adoption of the 'new technology' which in the context of this research is the use of maggot therapy. Early majority are the pragmatists; this group will be the most likely to reference the evidence of the efficacy of maggot therapy. The early adopters and early majority is the area in which the adoption of maggot therapy may increase exponentially (Wills, 2012). In 'bringing up the rear' the late adopters and at the heel of the graph, the laggards are those practitioners who may respond to peer pressure or in the latter; those who want to maintain the status quo i.e. traditionalist (Rogers 2003)

Participants from a Health Board in South Wales were recruited using non-probability purposive sampling (congruent with a phenomenological methodology, Parahoo, 2006). Participants were invited via group emails which included a recruitment poster, a frequently asked questions sheet, and a Consent form. Interviews were carried out at a University setting to protect nurse anonymity. Interview durations were between 32 minutes to 1 hour fifteen minutes. With consent the interviews were recorded and transcribed verbatim and uploaded onto MAXQDA Plus 2020 (VERBI GmbH, Germany) to assist in data management (Kuckartz, 2014). Roger's Diffusion of Innovation Theory (Rogers, 2003) and Ajzen's Theory of Planned Behaviour (Ajzen, 1991) were employed as a framework to conceptualise nurse's perceptions of the use of maggots as a therapeutic option in wound debridement.

Data analysis

The thematic analysis of the qualitative data obtained from the focus group was used to inform the design of the survey employed in the second stage of the study.

For stage 2, descriptive statistical analysis was undertaken in MS EXCEL and SPSS Version 22 for Windows. Correlations and tests for significance between the survey findings were analysed using One-Sample T-Tests and Independent Samples T-Test. Significance level was set at $p \leq 0.05$.

Stage 3 one-to-one interviews were analysed using thematic text analysis. Following an iterative process, this involved coding and re-coding of the nurse participants historical past, their present and their future relationships and perceptions of maggot therapy, by constructing and re-constructing the meanings of their spoken narratives and non-verbal cues (Kuckartz, 2014; Mackey, 2005).

Ethical approval

Research Ethics Approval was granted by Swansea University College of Human and Health Sciences Research Ethics Committee (Refs: 011117 and 220818).

Results

Stage 1 - Results of Focus group

Key themes which emerged from this discussion are shown graphically in Figure 3. Issues identified within the focus group of senior nurse wound-specialists (TVNs) included practical problems with ordering and dispensing MT, and the hassle associated with this. The group reported that there was no national set pathway to incorporate the use of MT in wound management and agreed that there was a need to normalise the therapy. The main points made by the focus group are summarised below:

a) Acceptance and perception of MT by nursing staff

From the five participants, there was overwhelming agreement that nurses and doctors were far worse than patients with regards to perception and acceptance of MT. Focus group participants said there was no “getting around” the Yuck factor and the myths surrounding MT needed to be acknowledged and discussed. There was a feeling that whilst the majority of patients were accepting of MT once the process and benefits had been described to them, nursing colleagues needed more convincing to use and accept MT. The participants felt that maggots often had negative associations, and there was usually a smell at the end of the treatment, and agreed that MT needed to be promoted more amongst their own colleagues, many of whom were fearful, and reluctant to help them out with application if needed. Participants also discussed how some colleagues were cautiously curious and how applying maggots in a ward setting always attracted a lot of attention. Consultants, junior doctors, nurses and other colleagues often came to watch the maggots as they were being applied.

b) Knowledge of MT within the nursing profession

Participants agreed there was very little education on wound management, and in particular a lack of education regarding MT on the nurse curriculum. Thus, many nurses lacked confidence in their ability to apply maggots correctly. Participants said that student nurses might see MT during their training if they happen to be on placement when MT being used, but that there was a need for knowledge and training in MT. They also felt the need for more MT nurse advocates, who passionately and strongly believed in the therapy, and who would promote it.

c) Barriers or hurdles associated with Maggot Therapy

Cost was identified as a barrier to the use of MT, but all participants felt that MT was a very cost-effective treatment, especially when compared to ordering hundreds and sometimes thousands of dressings that were never used. However, a major hurdle identified within the focus group was a “hassle factor” associated with ordering and administering MT. Maggots were not seen as the first option but usually used as the last line of treatment, often used as a desperate measure when all other options had been explored. It was the decision of the Tissue Viability Nurse (TVN), as to which treatment to use when they come across a suitable wound. There was an agreement by participants that nurses, both acute and community-based, were reluctant to order maggots often because the ordering process could be extremely long-winded and unclear. They believed the main barrier to using MT was more about this hassle factor which was largely associated with administrative issues of ordering and paying for MT. Participants also mentioned the lack of a prescriptive care pathway and guidelines for the incorporation of MT within wound management.

Stage 2 - Results of online survey

Overall analysis of survey responses

One hundred and sixty-five nurses responded to the online survey. Of these, two only partially completed the survey and three omitted to put down their job description within the profession, so could not be classified as either WS or NWS nurses. These five responses were excluded from the data. Of the remaining 160 survey participants, there were 57 nurses within the wound specialist category (WS) and 103 nurses in the non-wound specialist category (NWS). Survey participants were mainly from the UK, although responses were received from nine other countries (including Canada, USA, Denmark, Malta, Barbados and Canada). There was a varied range of ages although 54.4% of participants were aged between 40-59 years. Most (91.3%) of participants said they were female. One hundred percent of WS nurses had heard of MT, and 97% of NWS had heard of MT. Table 1a and 1b summarise responses obtained from WS and NWS nurses respectively, for a series of statements on usage and perception of MT. (Sporadically a participant omitted to respond to a particular statement, so final percentages were worked out on the total number of responses obtained for each statement).

Responses to statements on usage and perceptions of Maggot Therapy (MT) as a treatment for chronic wounds.

Wound Specialist Nurses (WS) (Table 1a)

Most WS nurses felt that MT worked as a treatment (98.2%) no-one felt that the idea of MT was stupid. There was a very high confidence level regarding usage, with

96.5% of WS nurses feeling confident to recommend or apply MT to patients. Maggot Therapy was considered as an immediate first choice for a suitable wound by 68.4% of WS nurses, significantly higher than those WS that disagreed with this statement (17.6%), ($p < 0.001$) and only 10.7% of WS nurses said they preferred more conventional treatments.

With regards to perceptions of MT, WS nurses appeared to express positive views. For example, very few said that the thought of MT made them feel ill (5.4%), or that the thought of MT made their skin crawl (7.1%) and, although 11.1% WS nurses said that maggots were disgusting, this was not significant compared to the number of nurses that felt they were not (82.1%), ($p < 0.001$). No WS nurses agreed that they worried that MT was unclean, and although a few worried that MT would hurt the patient (3.6%), the vast majority of WS nurses did not (94.6%), ($p < 0.001$). Interestingly, 87.5% of WS nurses agreed that they liked maggots, although 10.7% were not sure, and 1.8% said that they did not like them (Table 1a). When asked if participants would have MT if they themselves developed a (suitable) chronic wound, 92.9% agreed that they would, compared to 1.8% who said they would not ($p < 0.001$).

Non-Wound Specialist Nurses (NWS) (Table 1b)

None of the NWS nurses felt that the idea of MT was stupid, and 81% felt that MT worked as a treatment (Table 1b). There was considerable uncertainty regarding confidence in using MT; although 49.5% NWS said they knew enough to be confident in recommending/applying MT to a patient, 34.9% said that they did not and 15.5% NWS nurses neither agreed not disagreed with the statement (Table 1b). Significantly, there were more NWS nurses agreeing that they would consider MT as

a first (immediate) option for a suitable wound (58.8% compared to 18.6% who disagreed ($p<0.001$). Likewise, more NWS nurses disagreed that they preferred more conventional medicines or treatments (45.5% compared to 27.7% who would prefer them, and 26.7% who neither agreed not disagreed).

Perception of maggots and MT varied for NWS nurses. For 24.8% of these nurses, the thought of MT made them feel ill, although more (61.4%) agreed that it did not ($p<0.001$). Almost a third of NWS nurses (30.7%) thought maggots were disgusting, and although 46.5% did not find them disgusting, a large proportion (22.8%) could neither agree nor disagree (table 1b). In addition, 31.7% of NWS nurses agreed that the thought of MT made their skin crawl, although a much larger proportion (61.4%), disagreed with this statement ($p<0.001$). The majority of NWS nurses were unworried about cleanliness of MT (78.2%) compared to 12.9% who were worried ($p<0.01$), and there were no significant concerns over maggots turning into flies on patients or the sensation of pain for the patient (table 1b).

Comparison of responses between WS and NWS nurses.

For ease of analysis of responses to MT usage and MT perception between WS and NWS nurses, Table 2 presents results comparing the responses obtained to statements from WS and NWS nurses, highlighting any significant differences. There were statistically significant differences observed between several responses, most notably regarding knowledge and confidence in the therapy (Table 2). For example, significantly less NWS nurses felt that they knew enough to confidently recommend or apply MT to patients (49.5% NWS nurses compared to 96.5% WS nurses; $p<0.001$) and significantly more NWS nurses said that they would prefer to administer more conventional medications and treatments (27.7% NWS compared

with 10.7% WS; p = 0.011). With regards to perception of maggots and MT, there were also many significant differences in response between the two groups of nurses. For example, more NWS nurses agreed that the thought of maggots made them feel ill (28.4% compared to 5.4% WS; p=0.001); more NWS nurses thought that maggots were disgusting (30.7% NWS compared with 10.7% WS; p = 0.003); more NWS nurses said that the thought of MT made their skin crawl (31.7% compared with 7.1%; p<0.001). Fewer WS nurses (3.6%) than NWS nurses (12.9%), worried about the cleanliness of MT, and significantly more NWS nurses worried that maggots would turn into flies on the patient (21.8% NWS compared to 1.8% WS; p=0.001). Finally, there were significantly less NWS nurses who agreed that they liked maggots (53.4%) compared to WS nurses, of whom 87.5% said they liked them (p<0.001).

Barriers to recommending/applying maggot therapy

Cost was identified by WS nurses as the most predominant barrier to MT (56.1%), (Table 3a), whereas for NWS nurses, it was a lack of confidence (94.8%). For 85.4% of NWS nurses, issues with application were also considered a barrier. Ordering and dispensing MT were issues for both groups of nurses, although more so for NWS nurses (Table 3a).

Additional barriers to Maggot Therapy

Seven WS nurses and 13 NWS nurses identified other barriers which they felt prevented them from choosing MT for their patients. These were thematically grouped and are presented in Table 3b. Patient reaction was highlighted almost equally by both WS (28.6%) and NWS (30.7%) nurses. Significantly though, 57.1% of WS nurses stated that the lack of support/willingness of other staff to help with MT, was a barrier to its use.

Stage 3 - In-depth interviews

A heterogenous group of twelve nurses were recruited from a range of clinical settings. Nurse participant characteristics are fully detailed in Table 4. The nurses were Tissue viability nurses (TVN), general registered nurses (GRN) and pre-registration student nurses (PRSN) (Table 4). Post qualification experience ranged from 5 to 37 years. The average number of years' experience was 21 years, and the median was 17.5 years. There were two pre-Registration nursing students, PRSN1 and PRSN2, who were 2 and 1 year respectively into their degree programme. All nurse participants were female. No male nurses or non-binary nurses were recruited. On completion of data analysis from in-depth interviews with these 12 participants, five main themes emerged. These were 'Disgust', 'Enthusiasm', 'Patient care', 'Barriers' and 'Education'. The latter three had the following sub-ordinate themes as follows:

- Patient care; the sub-ordinate themes were patient centred care, efficacy or best option, nurse autonomy, and family support.
- Barriers sub-ordinate themes were patient perception, lack of practitioner knowledge, treatment environment and costs and procurement processes.
- Education's sub-ordinate themes were cradle to grave of maggots, wound care commencement to resolution, and industrial visits.

Nurse participants were very candid in their responses and were very open about discussing their previous exposure or experiences with maggot therapy.

The results of interviews obtained from this section of the project are presented below together with a discussion of the findings.

Discussion

Stage 1 and Stage 2

Findings from Stage 1 and Stage 2 of our study show that not all nurses were at ease with MT or felt confident about MT as a treatment for chronic wounds. When responses were broken down into two categories based on whether nurses were regarded as having received some training in wound management (designated as “wound specialist” nurses (WS) e.g. Tissue Viability, Practice, District and Community Nurses) or those who had not (designated as “non-wound specialist” nurses (NWS) e.g. staff nurses and registered general nurses), differences were seen in attitude, confidence and readiness to use MT. In particular, NWS nurses were more likely to feel disgust, and feel ill at the thought of maggots, with almost one third saying that the thought of MT made their skin crawl. Disgust can be defined as an emotional reaction that activates the parasympathetic nervous system, generates feelings of nausea and a characteristic facial expression, and results in the behavioural avoidance of a stimulus (Rottman, 2014). The fact that these feelings were not expressed as greatly by WS nurses, perhaps suggests that WS nurses have somehow overcome their squeamishness about maggots. Several studies suggest that this may be because nurses who are involved in administration of MT discover how effective it can be for a patient with a long-standing ulcer, and after seeing for themselves how quickly and successfully maggots work to debride and help clear a wound, are more ready to embrace the notion (Courtenay, 1999; Dumville et al, 2009b; Jones et al 2011). The detailed study by Dumville et al (2009b) interviewed 22 community and clinic nurses in the UK, 19 of whom had experience of using maggot therapy. All nurses interviewed were unanimous in the

belief that maggot therapy achieved a speedy debridement of sloughy/dirty wounds, resulting in dramatic visible improvement in the condition of the wound. Nonetheless, the study found that half of all nurses interviewed expressed varying degrees of squeamishness linked to a general dislike of creepy crawly creatures, and a distaste for the wriggly movements. And out of the three nurse participants who had never applied maggot therapy, two of these attributed their reluctance to use MT, to their own squeamishness. In our study, 68.4% of WSN said they would immediately recommend maggot therapy for a suitable wound. This suggests that other factors play a role in its choice. Dumville ett al (2009b) found that nurses appeared to work within a personal hierarchy of tried and tested approaches, and it is reported that several wound clinicians still consider MT only as a last resort (Gray, 2008; Sherman, 2009).

A significantly higher level of confidence regarding use of MT was apparent in WS, but this is hardly surprising since WS nurses may have received better training in MT than NWS nurses; with only approximately half of the latter saying they felt confident about the treatment. Our survey also found that NWS nurses worried more about maggots turning into flies and about cleanliness of maggots that were used clinically. Knowledge about preparation of maggots for clinical use, and basic education regarding maggot life-cycle may be lacking for general and NWS nurses, giving rise to these unlikely fears and unnecessary worries.

Of great significance, however, was the fact that surveyed WS nurses identified, as a barrier to MT, the unwillingness by other members of nursing staff to help them

administer MT or support them with the ongoing therapy. This finding confirmed the thoughts expressed in our initial focus (stage 1). It is likely that the higher levels of innate dislike evident in NWS nurses manifest in a reluctance to help with the therapy. Specialist nurses interviewed by Dumville et al (2009b), felt there was a need for increased training of nurses working in general hospital wards and community, aimed at increasing awareness and use of maggot therapy by nurses other than those directly involved in tissue viability. Jones et al, (2011) suggested that education and training for staff nurses surrounding maggot therapy was essential in order to break down barriers to MT, and surmised that whilst it would be extremely costly to train all qualified nurses on a one-to-one basis, vital information about MT should be cascaded down by an MT trained nurse, possibly with the help of explicit informative leaflets made available to all nurses. Many separate NHS Trusts and Health Boards in the UK issue their own guidelines for the use of sterile maggot therapy in wound management, and an All Wales TVN Forum guidance for use of Larval Debridement Therapy (2013) was published designed to support all qualified healthcare professionals in managing wound debridement using larval therapy.

Additionally, nurses identified cost of MT as a barrier. In a previous study, it was reported that if nurses felt MT was the most suitable treatment for a particular patient, they were unable to prescribe maggots themselves, and had to rely on GPs or other doctors to generate the prescription necessary to obtain maggots (Dumville et al, 2009b). Nurses felt this was problematic, as some doctors lacked interest in wound care yet maintained a tight control on the prescribing budget. The cost of MT was considered high in comparison with other dressings.

At the time of undertaking Stage 1 of our study, nurses identified issues with ordering and dispensing of MT. Whilst it is acknowledged that practical issues exist with ordering and administration of MT, such as problems with days on which maggots could be ordered or delivered etc., BioMonde, (UK provider of clinical grade Larvae), has tried to address some of these issues. Now, an order placed with the company by 2pm is delivered free and early the following day, and nurses can also now order maggots on a Friday for a Monday delivery (BioMonde *personal communication*).

Stage 3

Discussion of supra ordinate themes from in-depth interviews

Five supra ordinate themes emerged. These were 'Disgust', 'Enthusiasm', 'Patient care', 'Barriers' and 'Education'.

Disgust

Nurse participants openly discussed whether or not they felt disgust towards MT. When probing participants about their historical past and their relationship with maggots, several participants expressed that they did not remember *when* their feelings of disgust emerged but rather were aware they had always been disgusted by maggots. This behaviour may have been learnt from their parents or evolutionary:

> *I think it's a learnt behaviour that you acquire over the years, possibly if your parents or someone goes 'eew' … a bit like spiders isn't it, I think you're like 'oh no its just a spider its fine' or you actually learn this fear, it's like 'oh my gosh it's a spider, run to the other side of the room' and I think it's probably*

similar with maggots that you know maybe people see them and, oh look at that maggot and then you kind of learn that behaviour (GRN1 para 47)

Just the other day I mentioned that I was going to do a project on maggot therapy and people stopped and they were looking…well they were grimacing and they were saying oh well I don't know, I don't think I could do that (GRN4, para 79)

These participants responses may also be attributed to human evolutionary psychology in that the feeling of disgust is associated with self-preservation. The disgust with maggots may be evolutionarily linked to need to ensure that as humans we have evolved not ingest material that is contaminated or likely to cause us harm (Rottman, 2014; Stevenson et al., 2010), therefore maggots were associated with bins, death decay and smell:

Well it's the squeamish thought of it I think, it is and maggots you associate, like you're saying there, the age of decomposing bodies or bins [laughing], you know, things sort of associated with perhaps not very nice things, (GRN6, para 126)

Not all participants verbalised disgust towards maggots. One participant, a general registered nurse could not remember a time in her historical past when she felt disgusted. This nurse expressed indifference towards maggots; maggots being a part of everyday life as she grew up:

I don't know. I suppose being brought up in the countryside, I've been exposed to all sorts of things, always having spiders in your bedroom and,

you know, butterflies, and moths everywhere. You just learned to live with them, maggots and things really and they're part of life (GRN8, para 75).

However, those nurse participants who, in their professional practice had handled maggots were appreciative of the disgust their colleagues and patients felt in relation to maggots as a therapeutic treatment:

I find that the families sometimes will go ooh, you know, and if they, they usually come to clinic with a relative and sometimes you will get a bit of negativity from, from a relative and some staff don't like maggots, you know, I've had some staff nurses point blank refuse to have anything to do with them (TVN2, para 114)

Stevenson et al (2010) demonstrated that the younger the child, the more expressive and the more influential is the role of parents in teaching young children disgust, however as children mature parents influence becomes a less important factor. This culturally specific experience is learnt at an early age (Siegal et al.,2011). However moving into adulthood this disgust becomes more fluid (Case et al.,2006), giving the potential to change the disgust participants (and potentially patients) felt towards maggots, to a more positive perception of maggot therapy. Here, education may play an influential part.

Enthusiasm

It is important to recognise that whilst some of the nurse participants in our study verbalised disgust, this did not preclude them from being enthusiastic about the curative properties of maggots in wound care. They verbalised that they would be prepared to engage with this therapy because their primary concerns were achieving the best outcome for patients. This presented an interesting dichotomy; disgust and

enthusiasm, but rather than being discussed as opposing poles, the narratives around enthusiasm were spoken of congruously. Some participants sought to balance inconsistencies with disgust and enthusiasm. The discourse of nurses GRN1, GRN4 and GRN8, who in the previous theme expressed their thoughts on disgust exemplified this. This enthusiasm was also expressed in their non-verbal cues. When discussing their perceptions, they became quite animated:

> *Because I think it would be quite satisfying to see their wound after… when it's lovely and clean (GRN1, para 23)*

> *I think it's because I have seen the evidence that it just works, you've got ulcers that aren't moving, they are just chronic and there is no sort of progression, I think it's just something different to use…(GRN4, para 37)*

> *Because, I'm enthusiastic about anything that increases wound healing, increases wound debridement, it's more natural than putting on something that's silver in origin that really doesn't do the job, (GRN8, para 150)*

As anticipated, the two tissue viability nurses who had been in tissue viability and wound care practice for 30 and 34 years respectively were the most enthusiastic about larval therapy:

> *I don't think I ever thought of maggots as disgusting because when maggots were introduced, when I first became introduced to maggots, I was more intrigued about the work that they did, how they could actually clean a wound and heal a wound. So, I saw the positive in them, I never saw a negative in them, and I didn't find it repulsive. I never found them repulsive because I*

was always focussing on what they could actually do, as opposed to, 'Oh my God, there's a maggot on somebody's wound' (TVN1 para 22)

I was very interested in wound care and at that time Professor XX was doing road shows … about wound care and so I got to go on 3 of these road shows and it really fired my passion for wound care and so I designated myself as a tissue viability link nurse …back in 1996 (TVN2, para 25)

In a similar vein GRN5 was also enthusiastic and her non-verbal cues augmented the understanding of her lived reality:

I think they're awesome. I'm happy to use them. Back when I was a student district nurse, I used maggots quite a lot because I was a caseload holder. And I went to the maggot factory and things like that, looked at how they were produced and had them put on my own arm, to see what it felt like, so that I could understand what I was applying to patients when I did apply it. (GRN5, para 33)

When probing participants on the origins of their enthusiasm it was apparent that the common denominator was that several were introduced to maggots at an early stage in their nurse practitioner training or their post qualifying professional practice. The efficacy of the use of maggots as a therapeutic option in treating chronic wounds was evidenced (Menon, 2012; Sherman, 2003; Sherman, 2014), and importantly these nurse participants had *witnessed* the curative abilities.

Viewing the participants enthusiasm of maggots through the lens of Rogers (2003) diffusion of innovation, TVN2 fell into the 'innovators' category. TVN1 and GRN5 could be said to fall into the 'early adopters' category. For the innovator (TVN2) the

advantage, efficacy, ease of treatment was immediately apparent, and for her, this led her to designating herself a tissue viability link nurse. She did not require an extended period of time to adopt this new biomedical technology. With regards to TVN1 and GRN5 the early adopters, which is the second fastest group, their typology suggests they have the highest degree of opinion leadership and are socially forward (Rogers, 2003). Both these nurse practitioners' curiosity needed to be satisfied, however once this happened, they too became advocates for this new technology. The catalyst in TVN1, TVN2 and GRN5's adoption may have been demonstrating practitioners (Bhattacharya & Singh, 2019), which going forwards makes them both ideally suited to be peer educators. The importance of the innovators and early adopters is that they became the influencers (Kaminski, 2011), who may be the drivers in a societal shift to embrace maggot therapy as an alternative to conventional debridement treatments.

The Early majority are characterised by individuals who adopt an innovation after a varying degree of time; the time taken for adoption being significantly longer than for the innovators and early adopters. For the late majority adoption of an innovation occurs after their average peers. They are typically sceptical about an innovation, may have a high degree of disgust and interact with peers who may have similar perceptions of maggot therapy. Latterly the laggards typically have an aversion to technology and are more inclined to focus on traditional solutions. On analysing the typology of the nurse participants no laggards were identified, however some participants recognised colleagues who presented the attributes of this category exampled by the narrative of GRN3:

> *From my experience, you know from the girls that I worked with who would just would not do the maggot dressing, (GRN3, para 87)*

GRN3 went on to discuss that these colleagues would only apply traditional gauze type dressings

Significantly the rate of adoption is reliant on relative advantage, simplicity, observability, trialability, and individuals perceptions (Dingfelder & Mandell, 2011; Mohammadi et al., 2018). Within the context of this research relative advantage referred to biomedical evidence that the use of larval therapy in wound debridement is more effective than alternatives;

> *I know that it has a very good use in the debridement of wounds, and I know it can be used for a wide range of (wounds), it's a good treatment for a wide range of wound management from the wound that's slightly sloughy to the wound has got an mess scar that can be pulpy,(GRN1, para 21)*

Simplicity relates to the ease of application i.e. bagged or free-range. TNV1 describes the importance of the method of application of maggots being a factor in adoption of larval debridement:

> *I don't want to change them', so it was difficult, and also some of them would only do the larval therapy if it was in the teabag, as we call them, in their little contained packages, because if they were free range they wouldn't. (TVN1, para 46)*

This statement is congruous with the narrative around the theme of disgust, which may be overcome by nurse practitioners being given a greater opportunity to observe and 'have a go', which again fits into the theme of education.

In relation to the late majority typology, GRN1 from her discussion may be described as falling within this group:

> *I think initially it would be 'oh my gosh' but I think the more you would do something it would just be 'well okay there we go that's just part of the job'. I think that's just me though, I think I do sort of take things in my stride, I tend not to try ..new things. (GRN1, 59)*

Whilst there is not an outright rejection of this therapy, there is a barrier that must be crossed which may relate to observability, trialability and the perception of maggots.

Treatment Outcome

A common theme with both TVNs, GRNs and PRNs was the emphasis on patient centred care in terms of attaining the best clinical outcomes and supporting the family in clinical decision making, with the nurse practitioner exercising autonomy in prescribing the most appropriate therapy.

Amongst patients, the perception is that the best option for them is pharma and not maggots which they associate with decomposition, faeces, stinking animals and decay (Morozov & Sherman, 2019). Practitioners expressed the view that in order to successfully engage with this therapy, as well as being competent practitioners who refrained from verbalising their own disgust, they had to instil confidence in patients and family in the efficacy of this treatment. In chronic wound conditions there are distinct phases. A wound becomes chronic when the healing process is stuck in one of the four phases; homeostasis, inflammation, proliferation, and remodelling and maturing (Sherman, 2014). Maggot therapy is effective at progressing the healing process when it becomes stuck in one of these phases. Semantics and how treatment is explained is key (Spilsbury et al., 2008). Practitioners are cognisant that

the way they explained treatment could either *put patients off* or encourage them to engage with this therapy:

> *Well you can't force anybody, but you know, tell them about the benefits and just …, give previous examples you know. Sometimes they change their mind just when you're talking to them and saying look you know, "it will work, this wound is going to heal much better if you let us do this therapy on you" and sometimes they say "oh go on then, go on" (GRN3, para 37)*

Importantly practitioners steered clear from technical terms or graphic lay-descriptions of the work workings of maggot therapy. One nurse practitioner described maggots by playing into the *traditional medication and pharma* narrative:

> *I think they're amazing little things, like mini surgeons. Yeah. And they do a lot of the work for you (GRN5, para 35)*

She felt that by presenting an explanation which was in keeping within the *traditional* or *biomedical* model, patients would be more amenable to engaging with maggot therapy.

Chronic wounds are often painful for a patient, and this may be in particular for patients who have a long history of unsuccessful resolution of their condition (McCaughan et al.,2015; Steenvoorde et al., 2005). Nurse practitioners are acutely aware of this, and therefore emphasise the pain relief aspect of treatment when encouraging patients to opt for maggot therapy as an alternative to traditional dressings which may not be as effective analgesically:

> *I tell patients "we had a patient before, and he said that it wasn't that painful compared to the pain of the wound"…the pain had subsided. Then I tell them*

"He could feel a little bit, but it wasn't painful because you know they were taking away the dead skin anyway. He said it wasn't painful, he said he thought it would be but once they were on, he said it actually improve the pain" that's what I say (GRN4, para 110)

Role of a patient's family

All the nurse practitioners in our study were in agreement that the decision to engage with maggot therapy was something that involved the family. In terms of engagement with treatment therapies, family members are key players when navigating the complexities of medication choices and compliance (Ojewale, Oluwatosin et al.,2019; Ojo et al.,2016; Pesantes et al., 2018):

I think if you get the family involved, … in supporting the patient and there is more support, then they can agree with it as well. They can help us to educate the patient and encourage them and say this is going to work… then I think they will be more happy to support the patient with it (GRN4, Para 98)

TVN1 explained that it was common for a family member to accompany a patient to the Out-Patients appointment to discuss their treatment plan. Most frequently the person accompanying the patient is a significant partner who lives with the patient. Questions frequently revolve around maggots escaping, whether a patient will feel them once applied, as well as treatment efficacy:

Family is another one, when you mention it to family, they're a bit like, , what if they escape, what if they run….', so I always tell them, no, there's special dressings that contain them, so there's permeable dressings where we water

them, and they can't escape… and people's fear of whether they can feel them as well, so you explain that the nerves there are damaged, you can't necessarily feel them, you might feel slight movement, but most people don't, so there's all these different things really and I'd always give them information leaflets and stuff like that. Some people would accept straight away, yes, I'll have it. Some people wanted to think about it, which was fine, you just give them the information and more often than not they say, yes, we'll do it. (TVN1, para 80).,

The final subordinate theme under 'treatment outcome' was nurse autonomy. Within this context nurse practitioners discussed the need to be able to apply the most appropriate dressing to the wound. Since the Wanless (2003) Report concluded that in the future 20% of the functions undertaken by the medical profession would be undertaken by *nurses* the health service has seen the evolution of the specialist nurse practitioner and nurse prescriber, which it could be argued has blurred the role of the traditional medic and the nurse. However, the nurse practitioners and in particular the tissue viability nurses were adamant that as skilled practitioners they should have the autonomy to prescribe the dressing that was best suited to the patient's clinical needs:

what I find is, we go into a patient or on the ward you see a wound, and you think, 'Oh yes, okay, that's a grade whatever, that's sloughy, that's infected', and we'll go and say, 'Right, we'll put that dressing on it'. Now we're free to choose a topical dressing or whatever, why can't we just say, 'Well we'll just put maggots on that then?' because you know the work the maggots will do will basically do a lot more work and in a lot quicker time and it'll be a lot more

comfortable for the patient than applying weeks or even months of dressings onto a wound (TVN1, para 48).

TVN1 was very passionate about ensuring the optimal treatment plan was engaged in when treating patients with chronic wound conditions, and clearly viewed the patient through a wider lens. Wound care is primarily led by nurse practitioners who have the autonomy to prescribe a wide range of dressings such as iodine, silver nitrate or honey based (Edwards & Stapley, 2010), and participants were keen to have maggot therapy added to the repertoire of treatments available:

Well, debriding wounds, some of the dressings that we use can be slow, and it can speed up healing. And that's quite a… yeah, that's quite rewarding that can get something to break up (GRN5, para. 35)

With more specialist nurses prescribing training, and in keeping with the drive towards providing greater care within the community, nurse autonomy in choice of wound dressing will be a key determinant in the quality of life of some patients with chronic wounds. Viewed through the lens of Rogers' Diffusion of Innovation (Rogers 2003), nurse practitioners' enthusiasm for maggot therapy as an alternative to traditional dressings in wound care, and their efforts to encourage patients to opt for this therapy illustrates the important role innovators and early adopters play in encouraging more reticent patient populations who may fall into Roger's late majority or laggards categories.

Cost and procurement Barriers

Nurse practitioners commented that a barrier to prescribing maggot therapy was the cost of treatment, the culture within the organisation and procurement practices,

which vary across departments, hospitals and on a wider scale, across health boards within the study area:

> *The costs were when I would have to prescribe them, so I would order them. Depending on the size of the actual teabags, we used to call them, when I was in practice I think, the last time I prescribed them I think the teabags that I needed were something like £700-odd. It might have changed now …, I don't know, costs change, but it was about £700, (TVN1, Para 50)*

Because of the initial unit costs of prescribing, it is often felt that conventional pharma alternatives should be tried first, before moving to the use of maggot therapy. This, it is felt, is the result of the culture within the organisation, and the drive towards financial expediency and the need for efficiency savings because oof the high initial unit cost. However, whilst the cost of treating chronic wounds can be quantified in financial terms, participants felt that organisational culture played a role in the decision as to whether to prescribe maggots as a treatment option. This was consistent with previous findings of Gillespie et al., (2014).

TVN participants believed viewing maggot debridement through the linear lens of financial cost failed to recognise from a holistic perspective the effect a chronic wound condition has on a patient. TNV2 expressed passionately the importance of viewing the benefits that maggot therapy has on the wellbeing of patients in terms of pain management, odour, patient mobility, healing, independence and autonomy, self-confidence, social interactions and speed of wound resolution. TVN2 was positive that there is a mood swing within the medical profession to prescribing maggot therapy because the cost benefit analysis was veering towards recognising the efficacy of this treatment option:

well it's cost effective isn't it because there's a high unit core, initially a high unit cost and we used to have a lot of problems with getting GPs to, to prescribe it but that doesn't seem to be a problem any longer, so there is a high unit cost initially but if you think that you can debride a wound in a week, where it would take you 2 months to debride it using autolytic debridement techniques, it's certainly cost effective (TVN2, para 82)

TVNs 1 and 2 were nurse prescribers. They discussed the complexities of ordering maggot dressings and the challenges of the procurement processes being an obstacle. This was in terms of 'signing-off' an order, the online ordering system and GP prescription writing, all of which were incompatible with the smooth movement from prescribing to applying the maggots:

so to get it, we've got to go through hoops to get it approved, yeah, because we order it through (the online system)…which is our ordering system, a requisition has to be created, it then has to be approved by 2 people before the order can be put in, so that's a little bit of a difficulty I think for people sometimes, you know, how do we actually go about ordering them. In hospital X they just write a prescription and it goes to pharmacy, so it's a simpler process, (TVN2, Para 153)

Over complicated and inconsistent prescribing and procurement processes present a hurdle to nurse prescribers and non-prescribing nurse practitioners when wanting to prescribe maggot therapy to suitable patients. This is in spite of the 'All Wales Guidance for the use of Larval Debridement Therapy' (2013), which details the prescribing and ordering process. In some hospitals a prescription needs to be signed by two doctors which is contrary to the guidance. This may lead to specialist

practitioners echoing the sentiment that “the medical profession has in response to nurse prescribing shifted its self from its prescribing role to one if a diagnostician in an attempt to re-impose its dominance over other health professionals” (Pritchard 2018).

Education

As discussed in the previous theme of disgust, the perception of maggots can be changed because the feeling of disgust is fluid (Case, et al, 2006). A means to overcome this is through changing the societal norm. Roger’s Diffusion of Innovation Theory proposes that for an innovation to be adopted it must be seen as the best course of action. Within the context of this research, there must be a shift in the societal system both at a micro level with health practitioners and patients, and at a macro level; the systems within which the individuals are operating, i.e. the health care system and ultimately the wider health arena. This shift may be facilitated by the innovators and early adopters.

Participants were all in agreement that this shift in perception must be facilitated through education from a student nurse level moving upwards. When questioned on their knowledge of the life cycle of *Lucilia sericata* PRSN1 and 2 admitted that their knowledge was extremely limited, disclosing that they did not have even the basic knowledge of the lifecycle of *Lucilia.* One of the pre-registration nurse students asked:

> *can they turn into flies? (PRSN2, para 196)*

GRN1 commented:

I'm imagining all these maggots munching down on this necrotic tissue, I mean I have no idea of what happens with it, (GRN1, Para 104)

This latter quote was expressed with laughter, however, this may have been more to hide her embarrassment at having 8 years post registration experience and limited knowledge of maggot debridement therapy, and GRN4 was quite candid about her lack of knowledge:

Well I think it's quite short, well I don't really know a lot about how they work, I just know they eat away at the dead skin. I'm not too sure about all of the life-cycle of a fly (GRN4, Para. 40)

What was ironic when discussing the theme of education was that the nurse practitioner with 37 years post registration experience (GRN8), had been exposed to maggots during her training. This was at a time when maggot therapy was in its infancy as a therapeutic alternative to pharmacological options.

As previously stated, in order to encourage nurse practitioners to embrace maggot therapy, education must be from the start of the student nurses' journey, through to post registration. Additionally, an education programme needs to be extended to registered nurse practitioners who are already in practice; included as a component of their continuing professional development (CPD).

An explanation of nurse practitioner change processes to a more positive attitude can be conceptualised around Ajzen's Theory of Planned Behaviour (Ajzen, 1991). Nurse practitioners' negative perceptions of maggot therapy may be the result of their lived experience and historical pasts; hence the yuck factor. Additionally, this negative perception is fuelled by the subjective norms; what, as a society we believe

is the yuck and disgust felt towards maggots because of their association with filth, death and decomposition. In order to change this perception, there needs to be a change in knowledge through concerted education programmes at all levels within the profession (and societally), such that the subjective norm and attitude move towards the more positive position, thus leading to more positive perceived behavioural control:

> *What I think is that it needs a massive educational drive and I think as nurses, nurses are very much agreed they need to see it. Not read about it, they need a wound before, during and after with the timeframes and the cost. (GRN2, Pos. 59)*

GRN2 is expressing the importance of seeing the evidence of the efficacy of maggot therapy in wound debridement as an alternative to traditional dressings:

> *We teach the student nurses, and I'll always teach them about maggot therapy and when the slides come up and maggots are actually on a wound, the automatic reaction is, 'disgust', but I'm like, 'NO, look at the work they do, look how fantastic they are', and then I'll go through the process. But it is very much educating, we educate our student nurses, but we need to educate the qualified nurses out there as well who maybe not have had contact with larval therapy and the work that it does so well, but it's definitely about education, definitely. (TVN1, para, 36)*

TVN1 is a strong advocate for maggot therapy; indeed, she could be described as an innovator. She sees the need to move nurse education through the entire stream of nursing in order to affect the widespread adoption of this *technology.*

Some nurse practitioners proposed that in order to increase knowledge of maggot therapy, short videos should be made available to view whilst for example on a night shift:

> *videos are fantastic, the little tablet videos… sometimes explaining in words doesn't always work, does it. So I think if you could see something on screen, something visual, something to remember…and it would be a good use of time and would improve everybody's general knowledge about maggots and their application (GRN5, para 118)*

This participant expressed this view because she felt that with the pressures of shift working and family commitments, it was not always feasible to attend training events, and that viewing training material during quiet nights would be an effective means of engaging with CPD learning material.

It is hoped that increased knowledge through a variety of educational methods for example CPD videos, hands on experience, and increasing nurse practitioner confidence, may be sufficient in changing nurses' perceptions of maggot therapy. Increasing practitioner education and disseminating the efficacy of maggot therapy to the wider population my lead to a shift in societies subjective norm. This together with nurse practitioner's perceived increased sense of behavioural control, i.e. their ability to engage with maggot therapy confidently and with conviction, may lead to the *intention* and subsequent inclusion of maggot therapy within their wider repertoire of treatment options for chronic wound conditions.

Conclusion

In summary, the aim of our current study was to evaluate the current perceptions, opinions and usage of maggot therapy amongst the nursing profession. We have found that there is a need to ensure that cultural and inherent aversion to maggots does not hamper the provision of the therapy by those able to administer it. More training and information on MT may help assuage negative perceptions, squeamishness and fears held by some nurses and will promote professional understanding, ensuring that maggot therapy is utilised to its fullest potential. Indeed, there is a call for incorporation of MT into nursing training institutions in other parts of the world (Cumber et al, 2016).

To overcome the barriers to maggot therapy and support its diffusion, there needs to be greater integration of the horizontal (nurse practitioners, patients and families) and vertical (local health boards) structures (De Civita & Dasgupta, 2007). Maggot therapy needs to be brought into the repertoire of treatment options for chronic wound conditions. To facilitate this, maggot therapy needs to be seen as a societal norm. This may be achieved through education of practitioners, and a more consistent approach to procurement across and within health care settings and across local health boards/ authorities.

The analysis and interpretation of the spoken narrative was framed around Rogers Diffusion of Innovation Theory and Ajzen's Theory of Planned Behaviour (Ajzen, 1991). The rationale for framing this research around these theoretical concepts is because the adoption of a new technology is not a linear process. It involves a change in attitudes to the innovation by the individual or group, which in this instance

was nurses' perceptions of maggot therapy, and the societal norms and behavioural control, and the ability to adopt and *operate or use* the new technology (maggots). It is through understanding the modus operandi, beliefs and attitudes of nurse practitioners that helps to explain and encourage the early majority, late majority and laggards to adopt the new technology. Education, and the mode in which this feeds into the early majority, is a key factor in moving adoption to a point where the adoption of the new technology reaches the critical mass point; at which point the adoption is self-sustaining. Short sessions on MT could be introduced into the final year of Nursing curriculums in the UK (already being trialled at Swansea University), to empower all nurses with a better understanding of this specialist treatment. The Yuck factor can be overcome through the enthusiasm of the innovators and early adopters, who as influencers, are championing the use of maggots.

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