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Published on: 01 Aug 2013 - Journal of Research in Nursing (SAGE Publications)

Topics: Coping (psychology) and Grounded theory

Journal of Research in Nursing
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Journal of Research in Nursing published online 6 March 2012
DOI: 10.1177/1744987111427418

The online version of this article can be found at:
http://jrn.sagepub.com/content/early/2012/01/11/1744987111427418

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SAGE
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Journal of Research in Nursing
1–18

DOI: 10.1177/1744987111427418
jrn.sagepub.com
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Evaluation of a multi-modal grounded theory approach to explore patients' daily coping with breathlessness due to chronic obstructive pulmonary disease

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Abstract

Conventional methods have not yet succeeded in capturing the complexity of how people with chronic obstructive pulmonary disease (COPD) cope with breathlessness during daily living. We used a multi-modal grounded theory (GT) approach to investigate coping. In this paper, we describe and evaluate the multi-modal GT approach, which encompasses videos of daily life activity, interviews, medical history, demographics, self-rated sensation of breathlessness, and physiological measurements. A formative evaluation was conducted according to the criteria that the data collection should strengthen the participants' ability to remember and narrate how they cope with breathlessness; capture the multidimensional aspects involved in coping with breathlessness; encompass tools for collecting both qualitative and quantitative data, providing the opportunity to generate, synchronize, and combine data; and be ethically justifiable. The approach should also be consistent with the GT methodology of generating a theory. Striving to develop and perfect the multi-modal GT approach was time-consuming.

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Apart from this practical challenge, the multimodal GT approach met all evaluation criteria. This approach has the potential to generate new knowledge and may become an important methodological contribution towards understanding the multidimensionality of coping with breathlessness.

Keywords
Chronic illness, clinical research, COPD, grounded theory, merging qualitative and quantitative data, self-management, pulmonary

Introduction

Traditionally, researchers have primarily used grounded theory (GT) in qualitative research (Glaser, 2008). However, GT is an inductive methodology that allows all types of data (qualitative and quantitative) to be used in any combination, integrating them in various ways (Glaser, 2008; Holton, 2008). Based on this methodological advice, we aimed to benefit from a multi-modal GT approach while investigating the multidimensionality of coping with breathlessness among people with chronic obstructive pulmonary disease (COPD). This article contains a description and a formative evaluation of the multi-modal GT approach.

Background

In their effort to cope with breathlessness, patients with COPD use strategies that span a variety of interacting physiological, cognitive, affective, and psychosocial dimensions (Campbell, 2004; Clark et al., 2009). Such patients often suffer from low self-efficacy, anxiety, hypoxia, hypercapnia, hypoxia-induced cognitive declination, skeletal dysfunction, weight loss or obesity, and other concomitant diseases, which together compromise the patients' breathing abilities and functional level (American Thoracic Society/European Respiratory Society, 1996; Kobayashi et al., 1996; Masuda et al., 2001; Nonoyama et al., 2007; The American Thoracic Society, 1999). Despite a growing body of associated knowledge on how patients with COPD cope with breathlessness, we do not know whether these physiological and psychosocial conditions may shape particular types of coping with breathlessness. Elucidating possible interrelations between coping types and verbal and nonverbal behaviour, thoughts, feelings, and impaired physical condition may render visible both physical and psychosocial indicators of coping preferences. Identifying these preferences may facilitate the process of individualising pulmonary rehabilitation efforts, thereby improving symptom control and quality of life, as recommended (GOLD, 2009).

Conventional data collection methods, such as interview, questionnaires, and observation have frequently been used to investigate the multidimensional process of coping with breathlessness (Baker and Scholz, 2002; Chen et al., 2008; Gullick and Strainton, 2008). However, these methods do not embrace the impact of COPD patients' physiological condition on coping. Where a discrepancy exists between research topic and research method, the likely result is insufficient knowledge about the topic in question (GOLD, 2006). Conventional research that pays limited heed to the multidimensionality of coping with breathlessness during daily life may therefore be a root cause regarding why current

pulmonary rehabilitation efforts tend not to have long-term effects, as evidenced by high readmission rates and persistently high levels of depression and anxiety due to breathlessness (Nici et al., 2010). Furthermore, hypoxia-induced cognitive decline followed by weakened memory and reduced linguistic skills (Nici et al., 2006) may impede patients' narratives about how they cope with breathlessness in their everyday lives (Michaels and Meek, 2004). This cognitive decline calls for an innovative research method to investigate coping with breathlessness.

We used a multi-modal GT approach that combined physiological, cognitive, affective, and psychosocial parameters. To our knowledge, no studies have yet utilised such a multi-modal GT approach in an effort to capture the variety of dimensions inherent in coping with breathlessness.

Aim

In this paper we describe and evaluate the multi-modal GT approach in helping patients who have COPD to cope with their breathlessness.

Methodology

Formative evaluation

A formative evaluation was conducted regarding the multi-modal GT approach. In line with Patton (2002), the purpose of the evaluation was to improve the approach by thoroughly monitoring and describing strengths and weakness and consequently offer recommendations for improvements. Thus, the evaluation of the multi-modal GT approach holds a description of pros and cons of the approach as an entity combining different methods.

Grounded theory methodology

GT is a general methodology to explore social processes and reveal the human characteristic of anticipating and responding to various life circumstances (Glaser and Strauss, 1967; Lomborg and Kirkevold, 2003). The methodological pivots are (a) an inductive approach, (b) an iterative process of data collection and analysis, and (c) a constant comparative analysis strategy that continues until the theory is fully developed and solidly grounded in the social field under study. Most commonly, GT is used in qualitative studies (Glaser, 2008) despite the fact that the methodology originally held the opportunity to generate theory from both qualitative and quantitative data (Glaser and Strauss, 1967; Glaser, 2008).

Criteria for developing and evaluating the multi-modal GT approach

The approach was prospectively intended to accommodate challenges in investigating coping among people with COPD, including possible difficulties with remembering and narrating experiences of coping with breathlessness; capturing and explaining the interacting physiological, cognitive, affective, and psychosocial dimensions in predominant coping types; and being ethically justifiable as dictated by The Helsinki Declaration (World Medical Association Declaration of Helsinki, 2000). Consequently, the formative evaluation was conducted according to the criteria that the data collection and analysis processes embodied in the multi-modal GT approach should strengthen the participants'

ability to recognise, remember, and narrate how they cope with breathlessness during daily living; capture the multi-dimensional aspects involved in individual preferences for coping with breathlessness; encompass tools for collecting both qualitative and quantitative data, providing the opportunity to generate, synchronise, and combine these data; and be ethically justifiable. The multi-modal analytic process should also be consistent with the GT methodology of generating a theory that fits the empirical area under study, works as an explanatory model, and has clinical relevance (Glaser and Strauss, 1967; Lomborg and Kirkevold, 2003).

Before evaluating the multi-modal GT approach, a substantiated description of the approach is offered to secure a foundation for assessing the validity of the evaluation produced. This description deals with: (a) the GT principles for conducting data collection and analysis processes; (b) data collection tools; (c) data analysis processes; (d) theory generation; and (e) ethical contentions. The multi-modal GT approach is retrospectively described, as data collection and analysis processes embodied in a GT are evident only after the theory is finally written up.

The multi-modal GT approach

The inductive and deductive principles for data collection and analysis. Owing to the ambitions of being inductive and open in the first phase of data collection while at the same time securing multidimensional data for exploring the complexity of coping, we prioritised gathering comprehensive data related to each participant, rather than including a larger number of participants. The theoretical sampling procedure guided both time and method for analysing this pre-planned data set, as well as for including and analysing continuously emerging data based on preliminary findings (Figure 1). Thus, the multi-modal GT approach evolved partly as a result of the theoretical sampling procedure and the four established criteria for developing the approach. The pre-planned data set consisted of video recordings, interviews, scores on the Modified Borg Scale (MBS) (Kendrick et al., 2000), bedside predicted forced expiratory volume in 1 second (FEV1%), measurements of peripheral oxygen saturation (SaO_2%), average level of metabolic equivalents (METs), energy expenditure, and step count, as these data types at minimum were assumed to have the power to meet the four criteria.

As recommended when generating a GT (Glaser and Strauss, 1967; Lomborg, 2005), the first author accomplished a three-phased data collection and analysis procedure that evolved from being 'open' to 'selective' to 'theoretical' in her approach to the research field. Following this three-phased procedure, the scope of research became more focused, resulting in both including new data sources and delimiting the data collection in relation to recording video, measuring numerous physiological parameters and scores, and transcribing interviews and videos, as no further understanding of the core category or subcategories appeared to surface during these procedures.

Data collection

Video-based narratives. To accommodate the difficulties that patients have with memorising and verbally expressing their experiences in living with COPD, 'video-based narrative' (VN) was chosen. VN was developed and tested prior to this study (Jørgensen, 2007), and has several methodological and epistemological advantages. VN comprises

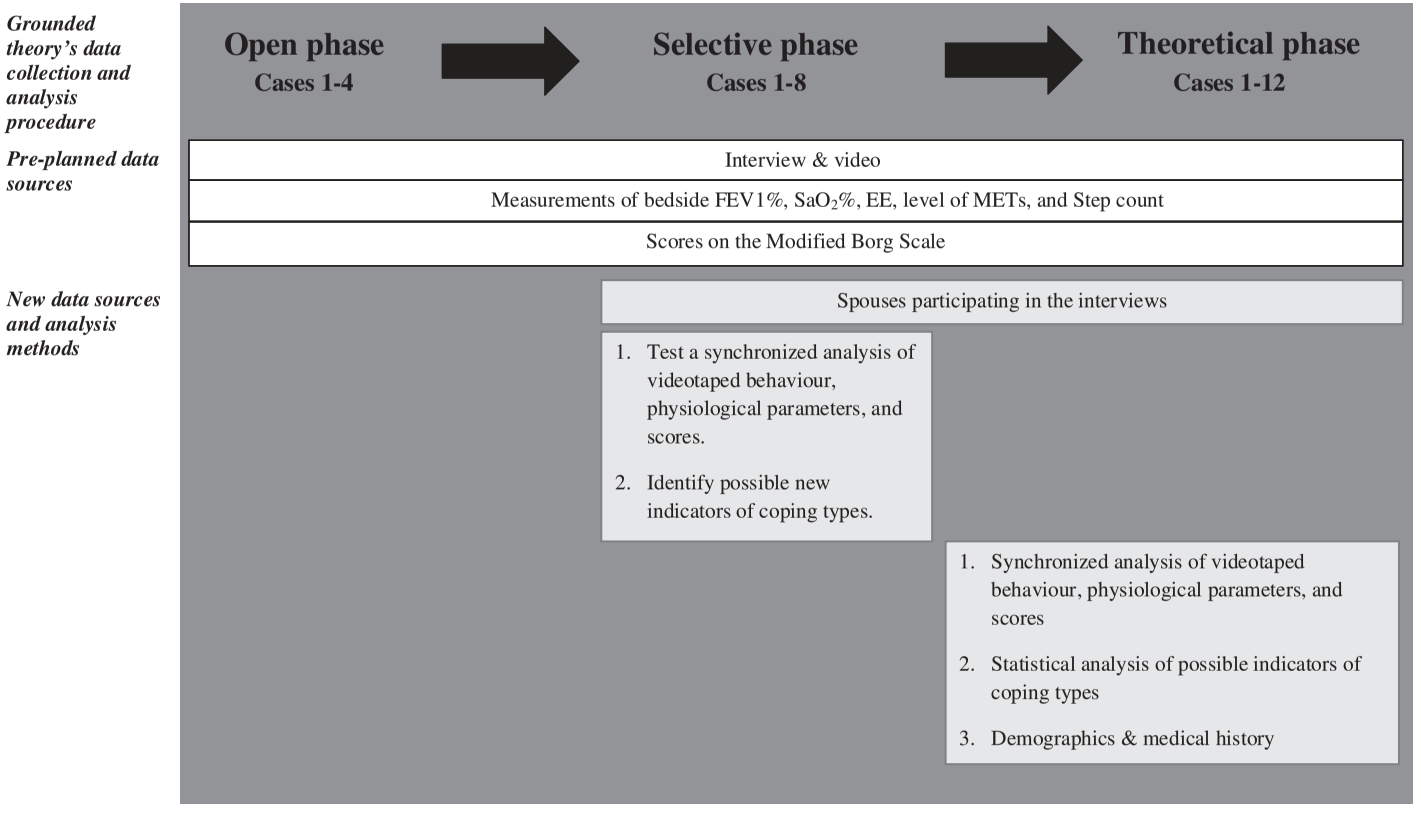

Figure 1. Flow diagram of the inclusion of pre-planned and new data sources and analysis methods during grounded theory's three-phased constant comparison

Table 1. Participant characteristics

ID	Sex	Age	Marital status	Primary health care service	Level of education[a]	FEV1% measured in outpatient clinic
A	F	64	Spouse	No	3	56
B	F	73	Widow	Yes	2	23
C	M	45	Spouse	No	3	41
D	M	77	Spouse	No	2	24
E	F	76	Widow	Yes	3	24
F	M	73	Spouse	No	2	26
G	F	72	Spouse	Yes	2	12
H	F	80	Widow	Yes	3	27
I	M	78	Spouse	Yes	2	39
J	F	70	Widow	No	2	27
K	M	79	Spouse	Yes	3	36
L	M	78	Widower	Yes	2	39

[a]Stage 1: primary education/first stage of basic education; Stage 2: second stage of basic education; Stage 3: (upper) secondary education (International Standard Classification of Education) (http://www.unesco.org/education/information/nfsunesco/doc/isced_1997.htm)

videotaping and subsequently interviewing the participant based on selected video sequences and an interview guide. This self-observation procedure during interview is a pivotal element in VN, stimulating participants' memory and ability to narrate (Davidoff et al., 1998; Horwitz et al., 2003; Jørgensen, 2007; Mihai et al., 2007). Video is a well-known and efficient research method, owing to its power of suggestion (Alrø and Dirckinck-Holmfeld, 2001; Knoblauch et al., 2006). In addition, self-observation provides both the participants and researcher with visual evidence of the participant's behaviour (Heath et al., 2010; Horstein et al., 2006). However, video only generates descriptive data regarding participants' behaviour. By combining video and interview, VN encourages participants to give meaning to these descriptive data on videotaped verbal and nonverbal behaviour. VN may thereby provide the researcher with an opportunity to conduct a particularly detailed analysis in comparison with conventional methods of field observation (Møhl, 2003).

In this study, VN encompassed videotaping the 12 participants living with stage II to IV COPD (GOLD). Details of the study participants are illustrated in Table 1. The participants were videotaped during personal body care (PBC), as this daily activity often elicits and worsens breathlessness (Leidy and Hasse, 1999; Lomborg et al., 2005; Nici et al., 2006; Partridge et al., 2010). PBC encompassed a variety of body care activities, such as showering or being washed when sitting in front of a sink; drying, rubbing, or moisturising the body; shaving; combing hair; brushing teeth; manicuring; and cleaning personal objects such as glasses and hearing aids (Lomborg, 2004). Video recordings of PBC sessions formed the basis of a dialogue between the participants and the researcher about how the participants coped with breathlessness during daily living.

Video sequences were selected on the basis of a video selection guide. This guide, the interview guide, and the guide for transcribing both video and interview were continuously developed and focused according to the three-phased data collection and analysis procedure (Glaser and Strauss, 1967; Glaser, 1978).

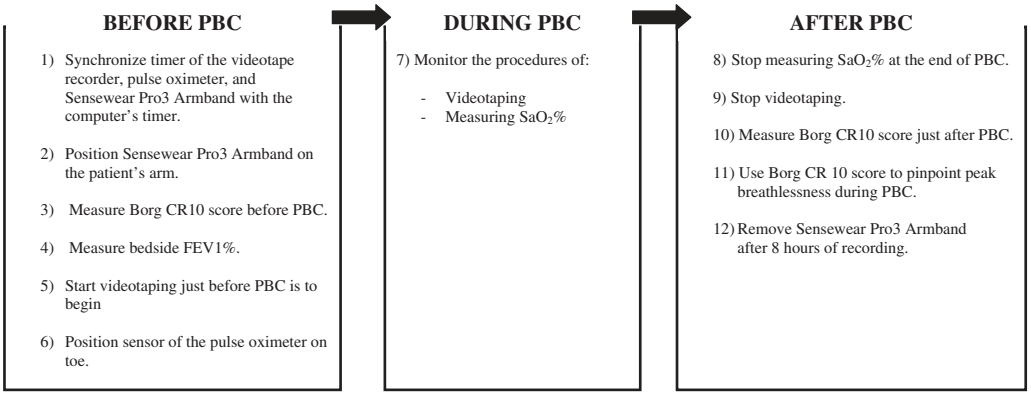

Figure 2. Flow chart for the preplanned data collection process during personal body care (PBC) on a day-to-day basis

Physiological measurements and scores on the Modified Borg Scale. In preparation for investigating possible interrelationships between coping types and the participants' physical condition, bedside FEV1%, SaO_2% and the level and intensity of activity were measured. In addition, the participants' experiences of breathlessness were measured on the Modified Borg Scale (MBS) to capture the subjective dimensions of breathlessness (Kendrick et al., 2000). Figure 2 depicts the process of collecting these qualitative and quantitative data before, during, and after PBC. Further arguments and descriptions of these choices are provided below.

As illustrated in Figure 2, a synchronised data collection process, comprising video recordings of the participants during PBC combined with measurements of SaO_2%, was conducted to display the participants' oxygen capacity during the process of coping with loss of breath. The probe of the pulse oximeter was placed on each patient's toe in an attempt to reduce interference with the participant's normal behaviour during PBC. Using MBS, participants ranked the intensity of their breathlessness before and after PBC, and their peak experience of breathlessness during PBC. These scores were intended to investigate variations in the intensity of breathlessness both within each individual participant and among participants, and ultimately to identify possible indicators of coping types.

People with COPD often emphasise their decreased level of activity as a hallmark of managing life with COPD (Leidy and Hasse, 1999; Katz et al., 2005). Therefore, to investigate a possible interrelation between activity level and way of coping with breathlessness, the participants wore a validated multi-sensor armband (SenseWear®, PRO3 armband; BodyMedia, Inc., Pittsburgh, Pennsylvania, USA) (Patel et al., 2007; Watz et al., 2008) positioned on the upper right arm (on the triceps and at the midhumerus) for two to three days. The portable armband contains two accelerometers, a galvanic skin response sensor, a heat flux sensor, a skin temperature sensor, and a near-body ambient temperature sensor from which data were stored minute by minute. Using the Sensewear 6.1 software, these variables, as well as body weight, height, handedness, and smoking status (smoker or non-smoker) were used to estimate the intensity of physical activity, which was expressed in METs. MET (Metabolic Equivalent of Task) is a term

used to express an average person's metabolic rate. A unit of metabolic equivalent, or MET, is a ratio comparing a person's metabolic rate while seated and resting to their metabolic rate while performing a given task (Ainsworth et al., 1993). Physical activity was measured for 8 hours per day for at least 2 consecutive days. The armband was removed only for safety reasons during bathing or showering. Synchronising the timer of the videotape recorder, pulse oximeter, and armband with the computer timer allowed for a synchronised analysis of the participants' videotaped behaviour and physical condition during PBC.

Demographics and medical history. In addition to the pre-planned data set, the following novel data types were included from the participants' demographic information and medical histories: sex, age, marital status, level of education, use of primary health care, participation in pulmonary rehabilitation, years since diagnosis, habitual FEV1% measured in the outpatient clinic, admission frequency, haemoglobin percentage at the time of admission, body mass index, use of ambulatory oxygen, and co-morbidities. In accordance with GT methodology (Glaser, 1978), these data 'earned their way' into investigating the multidimensionality of coping with breathlessness by constituting possible indicators of coping types. Demographic information was gathered from participants' self-reports, while medical histories were obtained from participants' medical records.

Data analysis

Analysis of video and interview transcription. All interviews and 32 of the videos were transcribed verbatim. The video recorded nonverbal behaviour was transcribed according to a transcriptional guide that evolved continuously throughout the three-phased GT procedure. Transcriptions of interviews and videos were analysed according to GT methodology, focusing on identifying and conceptualising (Glaser, 2001) the possible interplay of participants' thoughts, feelings, and nonverbal behaviour, constituting coping types (Figure 1). This analysis was conducted throughout the three phases in the constant comparative analysis supported by the software program NVivo8.

Synchronised analysis of videotaped behaviour and physical parameters. The synchronised analysis was accomplished in the selective and theoretical phase. Video literature emphasises that a high density of video data permits thorough data analysis, but at the same time carries a risk of overwhelming the researcher (Bottorf, 1994; Alrø and Dirckinck-Holmfeld, 2001; Hammersley and Atkinson, 2006). To accommodate this challenge while still attaining a profound data analysis, we developed a time-table facilitating the simultaneous diachronic and synchronic scrutiny of videotaped behaviour and other preliminary coping style indicators that emerged through the process of selecting video sequences for use in conducting VN and the process of transcribing video. When conducting the synchronised analysis, two screens were used to synchronously play the video and the graph illustrating SaO_2% and heart rate. The pinpointed peak experience of breathlessness became a point of reference for the synchronised analysis, which focused on coping indicators such as behaviour, SaO_2%, MBS score, respiratory rate, pauses in activity, and involvement of a helper (professional or spouse). Special attention was paid to each indicator before and after incidents of oxygen desaturation and signs of escalating breathlessness by applying a scale for monitoring signs of severity of breathlessness that were constructed for this study (Figure 3).

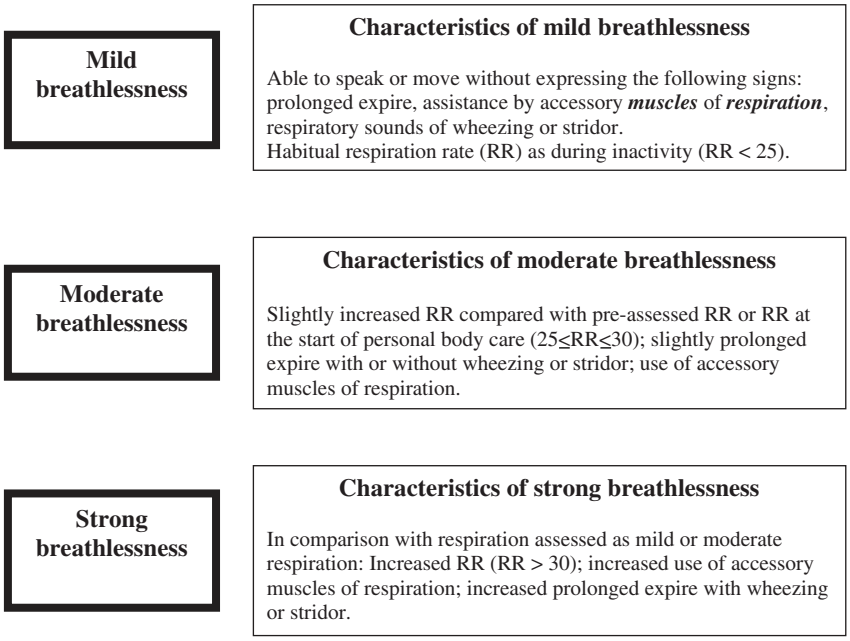

Figure 3. Scale for monitoring the severity of participants' breathlessness

Merging preliminary coping types with possible indicators derived from the analysis. As illustrated in Figure 1, final saturation of the generated theory on predominant coping types of patients with COPD was accomplished by merging all of the data and investigating possible convergence between various patterns that emerged through the above-mentioned analytic processes and the inclusion of medical history and demographic information. This investigation was conducted in four steps:

(1) Participants were classified according to the four identified yet preliminary coping types. No statistical analyses of possible indicators of predominant coping types were conducted at this step.
(2) Next, preliminary coping type classifications of the participants and possible coping type indicators were incorporated into an Excel spreadsheet. The possible indicators embraced behavioural and physiological parameters, demographics, and medical history, and included: FEV1% measured during pretest of an outpatient spirometric measurement, bedside FEV1% measured just before starting PBC, SaO_2%, energy expenditure, average level of METs, step count, level of activity (sedentary, moderate, vigorous, or very vigorous), body mass index, haemoglobin percentage, treatment of ambulatory oxygen, MBS scores, marital status, years since diagnosis, readmission frequency, and information about whether each participant received help from domiciliary care, and whether he or she currently participated in or had previously participated in pulmonary rehabilitation.
(3) By letting one indicator at a time determine the classification of the remaining coping type indicators, remarkable indicator patterns between the preliminary coping types came to light, enhancing understanding of the coping types.

(4) Statistical analysis was conducted by pooling possible coping type indicators that were observed during the synchronised analysis. These possible indicators were: bedside FEV1% before PBC; MBS scores before, during, and after PBC; respiratory rate; peripheral SaO_2% during PBC; and pauses during PBC. The tests illuminated differences in the majority of indicators between the preliminary coping types, and thereby further augmented the theory regarding four types of coping with breathlessness during daily living among people with COPD.

In total, we collected 50 variables containing physiological, cognitive, affective, and psychosocial information about each participant. The theory of how people with COPD cope with breathlessness during daily living was grounded on data from 24 interviews, 40 video recordings, 32 video transcriptions, 40 sets of measurements of physiological parameters, 40 sets of MBS scores, and 12 sets of demographic information and medical histories.

The process of generating the grounded theory

In retrospect, it became obvious that the core category and subcategories (i.e., the coping types) were based first and foremost on interviews and video, while the measurements, medical history, FEV1% indicating COPD stage, and statistical analysis of possible coping indicators observed in the videos both saturated the core category and generated additional subcategories. Therefore, methods apart from interviews and video substantiated and augmented the growing theory on how patients with COPD handle breathlessness during daily life.

The constant comparative analytic process steadily produced categories with pertinent interrelationships, generating a hypothesis about how patients with COPD coped with breathlessness. This process formed the basis for theoretical sampling. For instance, the first included participant's coping behaviour with moderate COPD regarding breathlessness persistently deviated from the following five included participants' behaviours regarding breathlessness. Several possible reasons for this deviation were looked for in the data material, including gender and FEV1%. Regarding the final two possible causes for this heterogeneity, the researcher endeavoured to implicate male and female participants with moderate FEV% in the ensuing inclusion process. Additionally, data revealed that spouses constituted a significant extra-personal and inter-personal resource in coping, and had a vital role in how participants handled a life influenced by breathlessness. Consequently, spouses were invited to participate in the following interviews regarding how their relatives coped with breathlessness.

Ethical contentions

The Danish Data Protection Agency approved this project (J. No. 2008-41-2266). According to the Scientific Committee for the County of Aarhus, the Biomedical Research Ethics Committee System Act does not apply to this project. All participants were informed both orally and in writing about participating in the study. Taking patients' vulnerability (Lomborg et al., 2005) and video recording's power of suggestion into consideration (Christiansen, 2001), two potential disadvantages were identified with regard to COPD patients participating in the study. First, being videotaped during PBC often naked,

breathless, and needing help might violate the participant's integrity. Second, using video in the form of self-observation might be overwhelming and unpleasant for the participant. The following developments were made to avoid these potential disadvantages.

Published literature underscores the importance of being alert to the potential risk of violating participants' integrity when using video, as in VN (Alrø and Dirckinck-Holmfeld, 2001; Knoblauch et al., 2006). Being aware of this potential risk, VN was developed and pilot-tested with special attention to ethical perspectives (Jørgensen, 2007). To avoid any violation of the participants' integrity, a covenant was developed (Alrø and Dirckinck-Holmfeld, 2001; Knoblauch et al., 2006) containing exact rules for video recording (e.g., recordings of personal intimate hygiene were not allowed); participants were offered the opportunity to abstain from participation at any time without any appraisal, and participants' statements were solicited regarding the further use of the obtained videos in various settings, such as conferences and teaching.

Both the methodological advantages and the risk of participants feeling violated arise from the psychological impact of employing video in the form of self-observation. Watching other patients suffering from breathlessness had no impact on the breathing of asthmatic patients (Phankingthongkum et al., 2002). However, one laboratory study indicated a risk of aggravating breathlessness in asthmatic participants by showing unpleasant pictures to patients (von Leupoldt and Dahme, 2005). Whether patients with COPD respond similarly to being confronted with themselves in a precarious situation (such as PBC) appeared to be unknown; to prevent such potential reactions, a short video sequence was played to the participants prior to their interview with the intention of habituating participants to self-observation.

The researcher must incessantly strive to find the balance between using the methodological advantages while preventing any violation of the participant's integrity. In striving for this balance, the researcher performed a psychological debriefing in the wake of every single interview. To reduce the possibility of psychological harm, the researcher encouraged participants to discuss their study participation experiences. In addition to debriefing, the researcher informed health care professionals to be alert to, and inform the researcher about, possible physiological and psychological reactions from the participants after being videotaped and interviewed.

Results

Evaluation of the multi-modal grounded theory approach

Developing and perfecting the method was time consuming. Apart from this practical challenge, the multimodal GT approach met all of the evaluation criteria, as substantiated in the following evaluation.

Ability to strengthen memory and narration in patients with COPD. The multi-modal GT approach clearly stimulated and supported participants' narrative abilities, as all participants not only narrated diligently, but also commented spontaneously on their videotaped behaviour: *'Take a look at me…I haven't caught my breath yet, and still I continue drying my leg.'* Watching themselves on the video produced awareness in the participants of how they coped in the video. By initiating the participants' verbal narration about their behaviour during PBC, the approach also sparked nonverbal

narration. It was striking to observe all 12 participants explaining how breathlessness felt, by using body language to simulate breathlessness and gesticulation to indicate suffocation.

Ability to generate, synchronise, and combine qualitative and quantitative data. The results from the analysis illuminated both the strengths and challenges in the multi-modal GT approach's ability to combine various types of data. The approach succeeded in engendering both qualitative and quantitative data, while also generating knowledge about how patients with COPD cope with their breathlessness. However, developing a multi-modal GT approach that would match the multidimensional coping process became a rather complex process. Collecting several types of data and using several types of data collection tools was manageable; however, analysing the extensive amount of data derived from different data sources demanded a continuous and thorough reflection on the purpose and method of combining these data. Based on repeated viewings of the video recordings, the development of the time-table and scale for monitoring signs of participants' severity of breathlessness facilitated the synchronised analysis and merging of data.

Video transcription and synchronised analysis became extremely time-consuming. Converting video into verbs seemed essential to fully grasp the interview data, owing to the interview data's partial foundation in video. The time consumption of the synchronised analysis, in particular, depended on the duration of videos and the verbal and nonverbal activity level during PBC. Furthermore, conducting this synchronised analysis required that incidents be replayed several times to observe and document the aforementioned preliminary indicators of coping types. The average duration of a video was 20 minutes. On average, these indicators (see below) were observed and documented every 10–20 seconds.

Achieving valid measurements of SaO_2% also turned out to be challenging. Ensuring proper position of the probe became an attention-demanding affair during PBC, as both movements and competing diseases (e.g., atrial fibrillation, poor peripheral circulation) may impede SaO_2% measurement (NONIN, 2005). The researcher continuously monitored the measuring process by being alert to signs of error measurements emerging on the display of the pulse oximeter. Repositioning the probe during PBC was often necessary; however, participants were warned of this demand in advance, and it seemed to cause a minimum of interference. These possible pitfalls were well known to the researcher before conducting the measurement. However, based on published literature and pilot testing of several probe types and positions, the chosen measuring procedure and device gave rise to the most reliable measurements.

Ability to capture multidimensional aspects of coping with breathlessness. The multi-modal GT approach made it possible to generate a theory capturing the multidimensionality of coping preferences among people with moderate to severe COPD (Jørgensen et al., unpublished). Based on both physiological and psychosocial data, the theory described four typical coping types comprising the participants' verbal and nonverbal behaviour, thoughts, feelings, psychosocial relations, and impaired physical condition. The grounded theory put forward a hypothesis that the four coping types may be reflected in FEV1% measured at outpatient clinics, bedside FEV1% measured before the videotaped PBC, average level of activity, degree of comorbidity, respiratory rate, SaO_2%, and frequency of pauses during PBC (Jørgensen et al., unpublished).

The major strength of the approach appeared to be its ability to capture and investigate possible interrelations between a variety of behavioural, psychological, physiological, and

social dimensions in coping with breathlessness. The large body of data will be a good basis for further exploration of the mechanisms behind coping types and their individual importance, which may highlight certain parameters for the use of identifying coping types. An article presenting these possible indicators is currently in preparation.

Ethical justifiability

Video literature underscores signs of video violating participants' integrity and modesty. Participants looking either at the camera or the camera holder, or making jokes on behalf of themselves, may convey signs of such indecent exposure (Alrø and Dirckinck-Holmfeld, 2001). Two participants smiled at the camera holder during their first video recording, making humorous comments on their altered looks. Eleven participants highlighted their changed appearances during the VN procedure in the hospital, compared with one during the procedure in the participants' homes. Despite this awareness of their appearances, no participants found study participation to be too unpleasant or overwhelming. Enhancing awareness of their behaviour through watching themselves on video, five participants suggested that video in the form of self-observation should be used in pulmonary rehabilitation settings.

Consistency between the multi-modal analytic process and grounded theory methodology

Conducting the constant comparative analytic process was feasible using both qualitative and quantitative data derived and analysed from a variety of data collection methods. The epistemological and ontological positions of GT methodology are vividly being discussed internationally, with a variety of positions being advanced (Annells, 1997a,b; Holton, 2008; Morse et al., 2009). In GT, the term *fit* is commonly used to express the relation between the empirical world under study and the theoretical account produced. Combining psychosocial and physical data calls for a position that explains how fit may consistently be understood across the different modalities involved in the study. Our study is in accordance with Lomborg and Kirkevold's reconsidered realist position, in which fit is claimed to be a matter of correspondence to fact in reality (Lomborg and Kirkevold, 2003). We have strived to secure fit, first and foremost by generating a theory based on categories emerging from careful studies of everyday living, while refraining from forcing data to fit pre-conceived or pre-existent categories and theories. However, fit might have been compromised due to the validity and reliability of data collection and analysis, as discussed in the ensuing paragraph.

Discussion

The multi-modal GT approach succeeded in combining various data collection and data handling methods, and captured the multidimensionality of preferences for coping with breathlessness. However, striving to develop a method that fully matched this multidimensionality also made the approach rather complex.

Performing the complex and detailed synchronised analysis might have impeded the validity and reliability of the approach. Thoroughly observing possible associations between varieties of preliminary indicators of coping preferences might contain a risk

of overlooking both identified and new indicators of coping types. Furthermore, observing pictures and videos might imply both personal and cultural differences in what is observed (Russ, 2007). The time-table may have decreased this risk, presenting guidelines and thereby specifying indicators to be observed (Russ, 2007). Still, the synchronised analysis process allows for a high level of detail, which made the process an attention-demanding procedure containing serious pitfalls of missing observations. Avoiding these pitfalls by choosing a software program with the ability to integrate multiple data modalities will consolidate the validity and reliability of the observations.

The multi-modal GT approach must be further developed as a consequence of how different observers may interpret what is happening in the videos (Russ, 2007). Human vision is based on recognition by comparing observations of the observed object and the observer's mental model of the observed object. Delimiting the observations to the recognisable might be a consequence of these conditions on human vision (Russ, 2007). Therefore, additional testing of indicators of how people with COPD typically cope with breathlessness requires consistent application of the approach, based on well-defined and labelled indicators of coping types as well as a profound description of the multiple processes of data collection and analysis. Allowing a software program to support the application of the approach may further improve the approach's transparency and applicability.

Video's power of suggestion may impede the validity and reliability of the approach and the generated theory. Video's ability to affect participants during the VN procedure requires reflection on how the media may have made an impact on both the data collection process and the results (Knoblauch et al., 2006). The video literature unanimously emphasises that the video recording of participants influences their behaviour (Alrø and Dirckinck-Holmfeld, 2001; Davidoff et al., 1998; Knoblauch et al., 2006; Mihai et al., 2007; Møhl, 2003). However, videotaped behaviour appears to be a condensed picture of the videotaped performer's life, offering knowledge about the observed social act and phenomenon (Møhl, 2003; Heath et al., 2010). This claim may be supported by the fact that the included participants' behaviour did not differ between the videos in relation to the chronology of PBC activities, completion of PBC activities, and coping with breathlessness.

In summary, the multi-modal GT approach met all evaluation criteria, as it has the power to strengthen the participants' memory and narration about how they cope with breathlessness; possesses the ability to capture the multidimensional aspects involved in preferences for coping with breathlessness; encompasses tools for collecting both subjective and objective data, providing the opportunity to generate, synchronise, and combine data; and it appears to be ethically justifiable. Furthermore, the approach is consistent with the GT methodology.

The multi-modal GT approach, encompassing the described methods for collecting and analysing data, is the result of meeting the four criteria for developing the approach consistently following GT methodology. A larger study population is required to determine whether the multi-modal GT approach offers more solid knowledge about coping compared with conventional methods. Nevertheless, this formative evaluation of the multi-modal GT approach illuminates the potential in combining video, interview, and other types of data to explore complex research issues, such as coping behaviour.

Conclusion

Despite the complexity of applying it, the multi-modal GT approach has the potential to generate new knowledge in a complex area, and may become an important methodological contribution towards capturing and understanding the multidimensionality of coping with COPD conditions in daily life.

The multi-modal GT approach had the power to investigate a complex phenomenon while taking into account the phenomenon's physiological, cognitive, affective, and psychosocial dimensions, revealing representative indicators of these dimensions. Regarding attempts to individualise pulmonary rehabilitation efforts, these indicators of coping types may constitute a more varied (and therefore more solid) foundation for improving health-related quality of life, including symptom control.

Key points

The multi-modal grounded theory (GT) approach was consistent with GT methodology, having the ability to:

- Strengthen participants' memory and narration regarding how they cope with breathlessness during daily living
- Capture the complexity in coping with breathlessness by encompassing tools for collecting both qualitative and quantitative data
- Provide the opportunity to generate, synchronise, and combine qualitative and quantitative data
- Be ethically justifiable

Conflict of interest statement

The authors have no conflicts of interest to declare.

Funding

This research received financial support from the Ministry of Science Technology and Innovation, Aarhus University, and Regions Hospital Silkeborg, Denmark.

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