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Stomas from a rural perspective

- An evaluation of characteristics, differences and improvement opportunities

Simon Näverlo

Department of Surgical and Perioperative Sciences
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"I always liked to take on the middle pockets, they're much harder."

Stephen Hendry – Snooker legend

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Abstract

Introduction

Stoma-related complications are common and consequences for the individual patient may be considerable. In rural areas, competence regarding stoma-related problems is largely absent. Since the aim of a publicly funded healthcare system is good healthcare on equal terms regardless of where one lives, studies evaluating differences and possible areas of improvement in rural areas are important. An evaluation of stoma-related characteristics, geographic differences and improvement opportunities from a rural perspective has not been done previously. The characteristics and differences studied in this thesis are: stoma reversal; occurrence of permanent stoma; and quality-of-life (QoL).

Methods

Epidemiological methods applied to register data were used in Study I. Data extracted from the National Rectal Cancer Register together with socioeconomic data from Statistics Sweden were used. Study II was a cross-sectional study using surveys matched with data from the National Rectal Cancer Register. Study III was based on data from a double-blind randomised controlled trial. Patients were randomised to either a prophylactic mesh or no mesh in order to prevent parastomal hernia (PSH). Quality-of-life was assessed by grouping and comparing results of questionnaires answered by the patients included. In Study IV, a qualitative explorative method was applied to describe the quality of life of rural living stoma patients. Qualitative content analysis was used to analyse data.

Aims and Results

Study I investigated whether distance by road to hospital had an impact on the following outcomes: stoma reversal rate; time from index operation to stoma reversal; and occurrence of permanent stoma after rectal cancer surgery. Longer distance to hospital had no effect on these outcomes in a multivariate model. In the univariate logistic regression model results indicated the opposite; patients living closest to the operating hospital had a higher likelihood of no reversal (OR 0.3; 95% CI 0.12–0.76). In northern Sweden, 77 % of all stoma reversals were delayed more than 6 months after index surgery. Stoma reversal was performed up to 1557 days after index surgery, and the shortest time to reversal was 82 days (median 287 days).

Study II investigated the impact of distance to nearest hospital on the QoL of rectal cancer patients who had received a stoma at index surgery. Patients living in rural areas reported more pain and sore skin compared to those living closer.

When only considering patients who still had a stoma, global QoL was reduced and stoma-related problems were also affected negatively in the rural group.

Study III Investigated whether a prophylactic mesh when creating an end colostomy affected QoL. No effect on global QoL was seen at one-year follow up. In several other QoL-parameters mesh patients scored superior compared to non-mesh patients, even when excluding those with a parastomal hernia (PSH).

Study IV investigated experiences of living with a stoma in a rural setting, how the process of seeking healthcare was experienced and the problems that occur. Results show that living with a stoma was experienced as a process; an initial sense of hopelessness, especially when suffering from stoma-related problems, progressing to the crucial acceptance of their situation. Stoma leakage was frequently described and experienced as unpleasant and unpredictable. Experiences of seeking healthcare in a rural district varied, some spoke warmly about the care given at the cottage hospital while other expressed dissatisfaction.

Conclusions

The notably high rate of delayed reversal of a defunctioning stoma in northern Sweden leads to unnecessary suffering for patients. In view of the long delay in reversal times seen, future studies must have considerably longer follow-up. Rural living rectal cancer patients who receives a stoma reported more pain than those living closer to the nearest hospital. Rectal cancer patients who still had a stoma reported an inferior quality-of-life and more stoma-related problems compared to their town counterparts. Results from the studies in this thesis show that the use of a prophylactic mesh when forming an end colostomy has no impact on subsequent global QoL. Rural living stoma patients commonly experience problems related to their stoma that affect their everyday living. Improved patient education shortly after receiving a stoma could help these patients in coming to terms with their situation.

Abbreviations

ATC Anatomical Therapeutic Chemical Classification system

ANX Anxiety

AP Loss of appetite (in C-30)

AP Abdominal pain (in CR-29)

APR Abdominoperineal resection of the rectum

AR Anterior resection of the rectum

BF Bloating

BI Body image

BMS Blood and mucus in stool

BP Buttock pain

CF Cognitive function

CO Constipation

CT Chemotherapy side-effects (Abbreviation from the EORTC questionnaires used in Studies II and III)

CT Computed tomography

DF Defaecation problems

DI Diarrhoea

DM Dry mouth

DY Dyspnoea (in C-30)

DY Dysuria (in CR-29)

DYS Dyspareunia

EF Emotional function

EMB Embarrassment

FA Fatigue

FI Financial impact (in C-30)

FI Faecal incontinence (in CR-29)

FL Flatulence

FSX Female sexual problems

FU Future perspective

GDPR General Data Protection Regulation

GI Gastrointestinal symptoms

HL Hair loss

HP Hartmann´s procedure

IBD Inflammatory Bowel Disease

IMP Impotence

LARS Low Anterior Resection Syndrome

MI Micturition problems

MSX Male sexual problems

NV Nausea and vomiting

PA Pain

PF Physical function

PSH Parastomal hernia

QLQ Quality of life questionnaire

QoL Quality-of-life

RCT Randomised controlled trial

RF Role function

SE Sexual enjoyment

SF Stool frequency

SF-36 Short Form Health Survey

SEXM Sexual interest (men)

SEXW Sexual interest (women)

SF Social function

SL Insomnia

STO Stoma-related problems

SRCR Swedish Rectal Cancer Register

SS Sore skin

SX Sexual functioning

TA Taste

TNM The TNM Classification of Malignant Tumours, Tumour Node Metastasis

UF Urinary frequency

UI Urinary incontinence

WEI Weight

WL Weight loss

Sammanfattning på svenska

Målsättningen med avhandlingen har varit att i ett glesbygdsperspektiv belysa olika aspekter som kan ha påverkan för personer med stomi. Fyra studier har genomförts. Syftet med två av dessa studier har varit att belysa skillnader i stomiförekomst och livskvalitet för stomiopererade boende i glesbygd jämfört med de i urban miljö. Studierna har fokuserat på om och hur avstånd till sjukhus påverkar dessa utfall. Erfarenheter av att leva med stomi för patienter boende i glesbygd har också belysts genom kvalitativ metod. I ett av delarbetena har en utvärdering av förbättringsmöjligheter för stomipatienter i allmänhet genomförts.

I Sverige saknas register över patienter med stomi. Det går därför inte att säkert säga vilken som är den vanligaste orsaken till att man får en stomi. Tjock- och ändtarms-cancer utgör sannolikt en av de vanligaste orsakerna. Utöver detta kan stomi anläggas vid inflammatorisk tarmsjukdom, urinblåsecancer, inkontinens eller andra, mer ovanliga, tarmproblem. Efter kirurgi för ändtarmscancer är stomin ibland tänkt som en permanent lösning och ibland som en tillfällig beroende på hur nära ändtarmsmynningen cancerförändringen sitter. I många fall fungerar stomin bra, men komplikationer är vanligt förekommande. Det är lätt att förstå att en stomi som inte fungerar som den ska påverkar patienterna både kroppsligt och själsligt. Bråck i anslutning till stomin är den vanligaste, och av många ansedd som den viktigaste komplikationen. Att anlägga ett nät i bukväggen i anslutning till stomin har beskrivits som en lovande metod att förebygga bråck men resultat rörande livskvalitet i samband med detta rapporteras sällan. Tidigare studier har visat att stomibråck sällan åtgärdas med kirurgi i Sverige vilket innebär att många får leva med sina besvär. Samtidigt saknas till stor del kompetens i glesbygd att handlägga patienter med denna typ av problem.

I glest befolkade områden är befolkningen ofta äldre och har en högre andel kroniska sjukdomar än i städer. Det är också här avståndet till specialiserad vård är som längst. När det gäller stomirelaterade problem finns kompetensen ofta på de större sjukhusen, långt ifrån patienterna som bor i glesbygd. Hur det är att leva med stomi i dessa delar av Sverige är inte beskrivet i litteraturen.

Studie I

I denna registerstudie undersöktes om och hur avståndet till sjukhus påverkade sannolikheten att inte få sin tillfälliga stomi nedlagd, efter kirurgi för ändtarmscancer. Likaså om avståndet påverkade tiden till nedläggning eller andelen som fick permanent stomi vid operationstillfället. Resultat från

regressionsanalysen där hänsyn togs till alla undersökta faktorer visade att ett längre avstånd till sjukhus inte påverkade dessa utfall. I modellen där enstaka variabler studerades sågs att de som bodde närmast de sjukhus som opererade cancerpatienter hade en högre sannolikhet att inte få sin tillfälliga stomi nedlagd. Vidare sågs att 77% av patienterna i Norra Regionen fick en försenad nedläggning av sin stomi, vilket definierats till nedläggning efter mer än sex månader.

Studie II

I denna enkätstudie undersöktes hur avstånd till närmsta sjukhus påverkade livskvaliteten hos patienter som fått en stomi vid kirurgi för ändtarmscancer. Enkäten besvarades av 129 patienter av 186 tillfrågade. Både de som hade kvar sin stomi och de som hade fått den nedlagd tillfrågades. Resultaten visade att de som bodde i glesbygd upplevde mer smärta och hudproblem än de som bodde närmare sjukhus. När man enbart studerade de som hade stomin kvar sågs en sämre livskvalitet och mera uttalade stomiproblem hos de som bodde i glesbygd. Dessa skillnader sågs inte när man jämförde de som bodde i områden med tillgång till stomisjuksköterska med de utan sådan tillgång.

Studie III

I denna studie undersöktes hur ett förebyggande nät i bukväggen med syfte att undvika stomibråck påverkade livskvaliteten. Patienterna lottades till att antingen få ett nät insatt vid operationen eller inte. I samband med en klinisk ettårsuppföljning ombads patienter fylla i enkäter, 148 av de 232 ursprungliga patienterna besvarade enkäten. När man jämförde grupperna med och utan nät sågs ingen effekt på total livskvalitet, men i enskilda kategorier rapporterade patienterna i nätgruppen bättre livskvalité, bland annat mindre stomirelaterade besvär.

Studie IV

I denna kvalitativa studie intervjuades 17 patienter med stomi boende i Södra Lapplands inland. Deltagarna intervjuades angående sina erfarenheter av att leva med stomi i glesbygd, vilka problem som kan uppstå och hur kontakten med sjukvården upplevdes. Intervjuerna analyserades med hjälp av kvalitativ innehållsanalys. Livet med stomi i glesbygd upplevdes som en process av tillvänjning och anpassning. Den första perioden beskrevs av många som hopplös, med svårigheter att sköta sin stomi. En del upplevde att deras stomi fungerade bra medan andra var ledsna och uppgivna över de besvär som stomin innebar. Många hade upplevt en ojämlikhet i vården. De patienter som haft möjlighet att fortsätta med sina fritidsintressen, såsom att vara ute i naturen,

upplevde detta som ett glädjeämne i vardagen. Dessa patienter upplevde också en känsla av att stomin inte utgjorde något hinder.

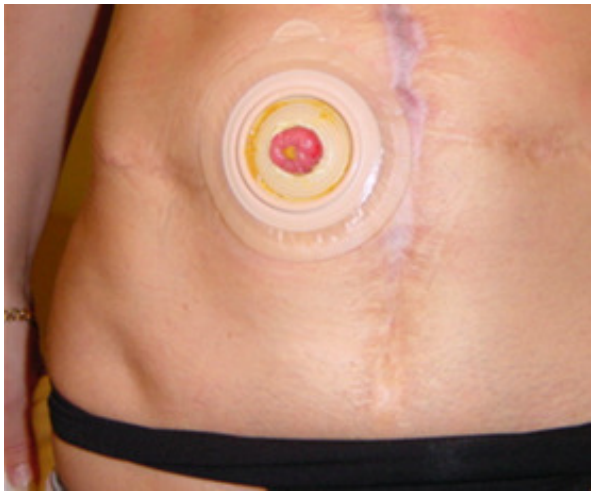
Slutsats

Tvärtemot hypotesen antyder resultaten att om man bor nära sjukhuset som opererar tarmcancer får man mera sällan sin stomi nedlagd. Den anmärkningsvärt höga andelen patienter som behöver vänta mer än sex månader på sin nedläggning har möjligen sin grund i en låg medicinsk prioritering. Denna fördröjning borde rimligen ha betydande effekter på vardagen för patienter med ändtarmscancer. Resultaten indikerar att de negativa skillnaderna i livskvalitet för ändtarmscancerpatienter som bor i glesbygd torde ha sin grund i geografiska ojämlikheter snarare än frånvaro av stomisjuksköterska. Den förhållandevis lilla positiva effekten på stomirelaterade besvär som ett förebyggande nät ger, beror - förvånansvärt nog - inte på ett förebyggande av kända komplikationer. En liten positiv effekt på stomirelaterade besvär utan någon effekt på total livskvalitet kan inte ses som ett argument för användande av förebyggande nät vid anläggande av änd-kolostomi. Många stomipatienter i glesbygd upplever besvär från sin stomi till den grad att det påverkar deras vardag. Bättre metoder för att hjälpa dessa patienter krävs. Ett ökat samarbete mellan specialist- och primärvård skulle kunna förbättra vården och underlätta för de patienter som upplever besvär.

Introduction/Background

Background

The word stoma originates from the Greek word for mouth or opening. Verbatim, the meaning is an opening within the body. In the context of this thesis, however, the meaning is usually enterostoma or urostoma: the diversion of faeces or urine through the abdominal wall using the intestine.



Stoma

Anatomically the diversion of faeces can be achieved using either the ileum or the colon, creating an ileostomy and colostomy respectively. Diversion of urine via an ileal conduit through the abdominal wall is another form of stoma called urostomy. In special cases, more proximal diversion of faecal content via a jejunostomy can be used at the expense of reduced nutritional uptake. This procedure is rarely performed, and the main indication is to bypass the small and/or large bowel because of obstruction or perforation. The resulting shortening of the alimentary tract with a jejunostomy has dramatic effects on the bowel's ability to absorb essential nutritional contents (short bowel syndrome) requiring parenteral nutrition in most cases.

Historically, the first description of a stoma, during the 18th century, was the result of fistula formation. According to the literature, the first surgical stomas were created at the end of the 18th century, one in a child with atresia of the anus and one to treat traumatic perforation of the abdominal wall [1, 2]. Such a

procedure at that time, without anaesthesia and antibiotics, must be considered nothing short of a miracle. The development of surgical and anaesthetic techniques in the 19th and 20th centuries, as well as antibiotics in the 20th century, have made surgical creation of a stoma and its effect on life afterwards something commonly encountered by both surgeons and patients.

It is easy to understand that in the 18th century, merely survival after stoma creation was sufficient to be satisfied with the outcome. Today, however, our expectations are considerably higher. The overall 30-day mortality rate for elective colorectal cancer surgery, a common reason for stoma creation, is 0,7-1,3 % [3, 4]. It is not only short-term survival that has significantly improved, even long-term survival and recurrence rates in colorectal cancer have markedly improved. Local recurrence after rectal cancer has fallen from almost 40 % in the 70´s to close to 3 % in recent data [5, 6]. Altogether this has led to an increase in the prevalence of patients with a stoma. The indication spectrum for stoma creation in Sweden is not clear because of a lack of such studies and registers are not available. It may be assumed, however, that colorectal cancer is the most common reason for stoma creation in Sweden. Other forms of disease can also lead to stoma creation, including inflammatory bowel disease (IBD), bladder cancer, faecal incontinence and diverticular disease, to mention a few [7-10].

One reason why there is not a stoma register in Sweden is probably the diversity of reasons to have a stoma. Consequently, accurate prevalence figures are difficult to acquire. However, all stomas require bandages, and in Sweden these are subsidised by the governmental agency for the subsidy of dental care and pharmaceuticals (Tandvårds- och Läkemedelsförmånsverket). All stoma dressings issued are registered by this agency which may thus be seen as a proxy measure of stoma prevalence in Sweden. In 2015, 43 000 people used subsidised stoma dressings giving a prevalence of 0,4 %, and of these about 3000 were patients equipped with urostomy bags [11].

Around 50% of patients with a stoma develop a complication [12]. Given the nature of the stoma, complications have both physiological and psychological consequences [13, 14]. In Västerbotten County, Sweden, the rural people is older, have more cardiovascular comorbidities and are less well educated compared to patients from the more densely populated towns [15, 16]. All these are known risk factors for many disease states, and stoma-related complications are not different [12, 17]. In the rural areas of Västerbotten county in northern Sweden, competence regarding stoma-related problems is also largely absent. Taken together, there is reason to believe that differences in healthcare exist to the disadvantage of the stoma patient living in these sparsely populated areas. Research into this important matter has not been carried out until now. Healthcare on equal terms is crucial in a publicly funded healthcare system. There

is little in the literature regarding stoma care for patients living in sparsely populated rural areas. Is there evidence that patients in rural areas receive worse care than those living in or around more densely populated towns?

Stoma-related complications and non-reversal of defunctioning stoma

There is a variety of stomal complications. A large prospective 10-year follow-up study reported parastomal hernia (PSH) as the most common (14%). In descending order, this study also reported bleeding, obstruction, ischaemia, fistula, retraction, prolapse, and stenosis as being other major complications (12.8% - 4.3%) [12].

Stoma prolapse

It is easy to understand that any of these complications can give rise to a wide range of symptoms and discomfort for the patient. Krogsgaard *et al* registered the symptom load before and after PSH repair surgery and found that the preoperative symptom load was high, the most prominent symptoms being a bearing down sensation of the stoma and pain (71% and 64 % resp.) [18]. Other symptoms included difficulties in finding clothes that fit or suitable stomal dressings, cosmetic complaints, activity limitations, leakage, erratic action of the

stoma, social restrictions and skin problems [18]. That one complication may give rise to several symptoms, should be a phenomenon that could be applied to other stoma-related complications as well.

Besides the purely anatomical division of an enterostoma between colostomy and ileostomy, one further categorisation exists *i.e.* permanent and defunctioning stoma. A permanent stoma, as the name implies, is a stoma created with the intention of being lifelong; a typical example being end-colostomy after abdominoperineal resection of the rectum (APR). A defunctioning stoma is usually intended to be temporary, either to protect, such as an anastomosis after resection surgery, or to divert e.g. in malignant colonic obstruction [19, 20]. A defunctioning stoma can also be permanent, e.g. a palliative measure in advanced colorectal cancer with threatening or present large bowel obstruction. In the case of defunctioning stoma after anterior resection for rectal cancer (AR), the intention is always to reverse the stoma and restore bowel continuity. The purpose of the stoma used in conjunction with AR is to reduce the risk of symptomatic anastomotic leakage [19], it has no long-term function. When fashioning a defunctioning stoma in malignant colonic obstruction, the diversion may be seen as a bridge to resection surgery, but also as a palliative measure with no intention of reversal as mentioned above. After a Hartmann´s procedure (HP) the intention is usually to reverse the resulting end colostomy thus restoring bowel continuity.

In the case of stoma after AR, it is well-known that a significant proportion of "temporary" defunctioning stomas become permanent [21-25]. Anastomotic leakage is the most cited risk factor for non-reversal, but high age, large tumour size and socioeconomic factors have also been described [26-29]. After AR in northern Sweden, the usual stoma is a loop ileostomy [23], but may also be a loop colostomy. A small bowel stoma disables passage of content through the colon, the organ primarily responsible for water and electrolyte exchange [30], and this physiological change has consequences for the patient. The ability to absorb water is reduced and faecal matter becomes looser. An episode of high stomal output from an ileostomy is therefore more likely to lead to dehydration than a colostomy.

Dehydration caused by high stomal output is a common reason for (re)admission to hospital after receiving an ileostomy. A retrospective Swedish study reported about one third (29%) of all patients with an ileostomy after AR having at least one episode of dehydration (defined as stoma output > 2000 ml) [14]. Half of these patients were readmitted, 2 % of whom needed ICU care. As well as dehydration, the presence of a loop ileostomy reduces glomerular filtration rate in the kidneys (eGFR) and increases the risk for developing renal impairment compared to prior to surgery [31].

Even though non-reversal of a defunctioning stoma cannot be classified as a stoma complication in its own right, it does contribute to the symptom panorama of these patients. In addition, it is widely known that the faecal matter of an ileostomy is looser to that of a colostomy. A large long-term prospective study also showed that an ileostomy is a significant independent risk factor for the major stoma-related complications mentioned above [12].

Altogether, stoma-related complications occur in about half of the patients and those who suffer from these complications have a high burden of symptoms. This is especially the case if the stoma is a loop ileostomy, where non-reversal of the stoma is against the main purpose of preserving the sphincter at the index operation. It is important that research evaluating risk factors for non-reversal (in most cases loop ileostomy) of a defunctioning stoma is carried out. Given the high prevalence and wide spectrum of symptoms caused by stoma complication, it is important that we conduct studies evaluating quality-of-life (QoL) in this group of patients.

Quality-of-life

In 1947 the World Health Organisation; WHO, defined health as: "A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" [32]. This holistic perspective on health is by some described as the starting point of the Quality-of-Life era. In one of the first publications on QoL, Elkington wrote in an editorial in *Annals of Internal medicine 1966:* "What every physician wants for every one of his patients, old or young, is not just the absence of death but a life with vibrant quality that we associate with a vigorous youth" [33].

A winter view of a lake in southern Lapland

Decision makers in Sweden have also made QoL an important endpoint by the introduction of legislation regarding patient involvement in decisions about their own healthcare. But how does one measure and compare something that by nature is not quantified? WHO have defined QoL as: “an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns.” [34]. When performing studies within the field of QoL, both quantitative and qualitative methods may be used. In general, the quantitative approach, in various forms, has been the most common, probably because this provides the possibility to compare QoL between groups, which is not possible in qualitative studies in the same way.

To measure and compare QoL, a questionnaire method is the most commonly used. One of the first QoL questionnaires was Spitzer´s QoL-index, published in 1981 [35]. In the case of colorectal cancer, specific and validated forms have been developed by the European Organisation for Research and Treatment of Cancer (EORTC) [36, 37]. These validated colorectal cancer questionnaires contain specific questions regarding the common symptoms of colorectal cancer and are named EORTC QLQ CR-38 or CR-29. Examples of symptom questions include blood and mucus in the stool, flatulence and stoma-related problems. This specific colorectal questionnaire is usually used together with a QoL questionnaire which, just as Spitzer´s form, comprises physical, social and emotional functioning [38]. This generic instrument is called EORTC QLQ C-30.

There has been no research addressing QoL of stoma patients in rural areas. When evaluating QoL after application of a prophylactic mesh in stoma creation, only two of ten studies from a recent meta-analysis reported QoL using a validated questionnaire [39]. One study used a stoma-specific questionnaire, *Stoma-QoL* [40], the other study used the SF-36 [41]. Just as QLQ C-30, SF-36 is an instrument assessing generic health, but SF-36 was developed for all forms of disease whereas the QLQ C-30 was developed for cancer patients specifically.

A tool often foreseen in order to gain a deeper knowledge in a specific topic is qualitative research using patient interviews. The amount of information received using this form of research makes it suitable for smaller sample sizes.

Until now, results from qualitative research on stoma patients has been sparsely reported, especially those living in rural areas. Krogsgaard published results from a focus group study on patients in urban areas with a stomal bulge using a qualitative method employing a phenomenological-hermeneutic approach [42]. Results from this urban study gave insight into the physical change that a parastomal bulge involves. This change leads to a negative effect on stoma care and a threat to the patient's control over their own situation.

Qualitative methodology and content analysis

Qualitative research differs in many aspects from quantitative research. As regards the concept of truth value, in quantitative research one describes validity, whereas in qualitative research this is credibility. Similarly, neutrality is described as objectivity in quantitative research while in qualitative research you speak of confirmability. The general definition of qualitative research according to Strauss and Corbin is "research that generates results that not has been produced through statistical method or other ways of quantify" [43]. For a scientist used to quantitative research, qualitative research can evoke a sense of frustration. Acceptance that quantitative and qualitative research originate from different epistemological backgrounds can be the first step towards understanding this methodology. This difference in epistemological backgrounds is substantially the largest difference between qualitative and quantitative research. Quantitative research has a positivistic origin and aims at finding generalisable explanations by studying parts of the picture or a sample. Qualitative research instead has a hermeneutic origin and aims to generate transferable results through understanding and studying the whole picture. Inherent to the nature of qualitative research, the truth is always subjective, in contrast to quantitative research where truth is said to be objective.

Data in qualitative research can be collected through interviews, observations, pictures or videos. There are numerous ways of analysing data, but in contrast to

quantitative research the method does not need a hypothesis. Instead, data can be analysed using an explorative approach.

Ironically, there is no objective description of the distribution of various qualitative methods in medical research. Commonly used methods in qualitative research are: grounded theory; phenomenology; and, qualitive content analysis.

Grounded theory was developed by Glaser and Strauss in the late 60´s [43]. It uses a 'backwards' approach compared to quantitative research. This method starts with no (minimal) preparation, no literature study and an open research question [44]. Using this approach, the researcher is, to a lesser extent, affected by pre-existing knowledge. The method is changed continuously during the project depending on the findings, hence the name *grounded* theory. All data are *coded* in smaller components that ultimately are combined and related to each other [45].

Phenomenology shares some of the features of grounded theory, *e.g*. data collection, but focuses on the essence of the phenomenon [46]. What then is the essence of the phenomenon? A better way of understanding this is to follow what the text says compared to what the text is speaking about, as this is judged to be the essence of the phenomenon. In order to accomplish this, a three-phased phenomenological-hermeneutic approach can be used. This method was first presented in a book by Paul Ricoeur and later described by Lindseth and Norberg [47, 48]. The method consists of a first step where a naïve understanding of transcribed text is gained from initial reading. In the second step, meaning units are found, and themes and sub-themes are abstracted. In the final step re-reading of the text is performed, where the text and already formulated themes are reflected upon in a wider perspective.

In this thesis, qualitative content analysis according to Graneheim and Lundman was used [49]. In contrary to phenomenology, qualitive content analysis aims to find variation instead of essence. Variance and similarities in the data are targeted through identification of the manifest and latent content. According to Graneheim and Lundman, data are condensed and coded, initially with a low degree of interpretation. The codes are sorted into categories and as the analysis proceeds, themes may become apparent to the interpreter(s). Themes are more abstract than categories and describe the latent content. Categories should be descriptive while themes should be interpretive. As the data collection proceeds, the knowledge within the subject hopefully increases and ultimately generates transferable results or new research hypotheses for quantitative research.

Prophylactic mesh

Parastomal hernia is the most common major stoma complication [12]. The reported incidence ranges from a few up to 78% [50-53]. That a PSH gives rise to problems regarding stoma dressing is easy to understand given the disrupted anatomy.

Parastomal hernia

In a study on a selected population with PSH, patients waiting for surgical repair had a high symptom load. This study, by Krogsgaard *et al* reported that nearly half of the patients (44%) have 2-4 symptoms related to their stoma [18]. Pain and a 'bearing down sensation' were the most commonly reported symptoms (71 and 64% resp.). That pain is associated with a bulge or hernia is consistent with sub-group results from a larger cross-sectional study by Näsvall *et al* [54]. In this cross-sectional study questionnaires were sent to rectal cancer patients, grouping the cohort into stoma and non-stoma patients. A difference in reported pain was only seen when comparing bulge/PSH patients to no bulge/PSH. On the other hand, in the wider non-selected population, no significant differences were seen regarding pain in rectal cancer patients with or without a stoma. This suggests that pain that stoma patients experience is largely associated with a bulge or PSH. According to the literature, recurrence rate, morbidity and even mortality associated with surgical PSH repair are unsatisfactory [55, 39]. In Sweden,

surgical repair is rarely performed, partly because of high complication rates [56]. A publication in 2018 by Odensten *et al* reported 71 surgical procedures intended to treat a parastomal hernia over a period of ten years in Sweden [56]. This surgical volume can hardly ease the burden of symptoms for patients with PSH and suggests that the number of patients that live with a symptomatic PSH is high, at least in Sweden. In neighbouring countries PSH repair rate is higher. Population-based data from Denmark, reveal that about 5-10 % of all PSHs are operated, corresponding to an annual volume (about 70) similar to that reported in Sweden over ten years [57, 55]. It should be mentioned that Odensten only received 67 % of medical records from patients who had possibly been operated for a PSH, and comparison of figures from this study with those from Denmark must be made with some reservation.

In the absence of a safe and effective surgical technique for PSH repair, various prophylactic measures against PSH have been tested at index surgery [53, 58]. No measure, however, has been able to reduce the PSH rate to a satisfactory level. Recent European guidelines state that there is insufficient evidence to favour open or laparoscopic repair regarding morbidity [59]. In the same guidelines, no recommendation regarding optimal technique for open surgery was made. For laparoscopic surgery, however, mesh without a hole was suggested in preference to a keyhole mesh.

Placement of a prophylactic mesh has also been tested to prevent parastomal hernia. Several smaller randomised studies and a meta-analysis of these studies showed promising results; prophylactic mesh seemed to prevent the development of PSH [58]. These studies, however, were small and used different mesh locations in relation to the abdominal wall. Another study reported no difference in PSH formation when evaluating the effect of mesh vs. no mesh [60]. Mesh itself is not without danger, which is why thorough evaluation prior to broad implementation is mandatory. Previous studies on mesh in different areas of the abdominal wall, have shown that mesh placement is associated with complications such as fistula formation, pain and a high complication rate [61-63]. In 2018, a large multicentre double-blind randomised controlled trial on this subject was published [64]. In this study Odensten *et al* showed that after 1 year, a prophylactic mesh in the sublay position did not prevent PSH clinically nor on computed tomography (CT). However, this study did not include analysis of QoL data. Given the previous reasoning that mesh is associated with pain and other complications, studies on QoL after mesh placement are important.

In conclusion, PSH causes a high symptom load for the patient. Surgical treatment is rarely performed in Sweden and the techniques available have a poor outcome. Finding a way to prevent PSH from developing, would make life much better for patients receiving a stoma. An evaluation of prophylactic options has

thus a natural role in this thesis, even if the main focus is on stoma care in rural areas.

Rural medicine

There is no uniform definition, based on distance or population density, of when medicine becomes rural medicine. Over time, however, many general practitioners have come to feel they belong to this category. One of the first publications on rural medicine is a book consisting of articles presented at probably the first rural medicine conference in 1939 [65]. General practitioners described the problems of practising in a rural setting, and how they should be faced [65]. Nowadays, societies for rural medicine exist at national and regional levels in many countries, including Sweden [66].

Even if there is no uniform definition of what rural means, several descriptions exist. Pastoral landscape, low population density, long distance to larger cities may all contribute when describing a rural area [67]. The U.S census bureau uses a somewhat different approach and defines rural as *not urban*, and by that a population of less than 2500 individuals [68]. In Sweden, a distinction has been made between *very sparse* and *sparse* rural municipalities. This distinction was made by The Board of Agriculture; a governmental expert authority responsible for the agricultural and horticultural sectors [69]. A *very sparse* rural municipality is defined as a municipality in a sparsely populated area with at least 90 minutes travel time to a town with at least 50,000 inhabitants. A *sparse* rural municipality is defined as a municipality with at least 50 % of the population living in a sparsely populated area and where less than 50 % of the population have at least 45 minutes travel time to a town with at least 50,000 inhabitants. The majority smaller rural municipalities in northern Sweden fulfil the *very sparse* criteria. Most of these *very sparse* rural municipalities are expected to face *extraordinary challenges,* both demographic and geographic, according to a report from a governmental inquiry [70]. The geographic challenges lie in the long travel distances to suppliers, customers and service. At the same time, the current basis and future development of the population limits the supply of appropriate competence *i.e.* a demographic challenge.

From a global perspective, Sweden is a sparsely populated country with 24,5 inhabitants per square kilometer: compare this with England with its 430/km^2 [16, 71]. In the three most northern counties in Sweden, the population density varies between 2.5 and 5 persons per square kilometers [16]. In the county of Västerbotten, a widely implemented health initiative exist; the Västerbotten intervention programme (VIP). Results from this programme show that rural areas in Västerbotten have an older population and higher prevalence of diabetes and cardiovascular disease [15].

To care for this rural population in northern Sweden with long travel distance to the closest hospital, a special form of primary care is present in northern Sweden; the cottage hospital. Numerically, cottage hospitals are most common in Västerbotten, but they are also to be found in the counties of Norrbotten and Jämtland. There are seven cottage hospitals in Västerbotten aiming to provide availability and continuity for the local population. They are open round the clock in case of an emergency and have a ward for in-patient care. In contrast to ordinary hospitals, these cottage hospitals are manned by general practitioners and nurses. Cottage hospitals aim to provide availability and continuity for the patients. Furthermore, they often have competence regarding the network around the individual person. A general opinion is that primary care works at its best when these factors are provided. Unfortunately, lack of general practitioners has led to inadequate manning and continuity. Continuity is the cornerstone of primary care and its absence has been shown to have a negative effect on mortality [72].

List of publications

I. Näverlo S, Strigård K, Gunnarsson U.

Long distance to hospital is not a risk factor for non-reversal of a defunctioning stoma.

Int J Colorectal Dis. 2019 Jun;34(6):993-1000

II. Näverlo S, Gunnarsson U, Strigård K.

Rectal cancer patients from rural areas in northern Sweden report mote pain and problems with stoma care than those from urban areas.

Submitted

III. Näverlo S, Gunnarsson U, Strigård K, Näsvall P

Quality of life after end colostomy without mesh and with prophylactic synthetic mesh in sublay position: one-year results of the STOMAMESH trial

Int J Colorectal Dis. 2019 Sep;34(9):1591-1599

IV. Näverlo S, Strigård K, Gunnarsson U, Edin-Liljegren A.

Experiences of living with a stoma in rural areas in northern Sweden

Submitted

Aims

Many intended temporary defunctioning stomas after rectal cancer surgery eventually become permanent. Does long distance to hospital increase the risk of not having a defunctioning stoma reversed after rectal cancer surgery? Many frequently occurring stoma complications require specialised care, competence that is often absent in rural areas. Does this affect the QoL of patients living in sparsely populated rural areas with no access to such care? The low reported rate of surgical treatment for PSH in Sweden suggests that many stoma patients are forced to endure their problems throughout life. Can the use of prophylactic synthetic mesh when creating a colostomy improve the patient's quality of life? For some patients, their stoma is a symbol of cancer survival, and for others the solution to their inflammatory bowel disease. The diversity of indications for a stoma influences the way it is perceived by the patient. How is it like to live with a stoma in a rural area? The overall aim of this thesis was to evaluate characteristics, improvement opportunities and experiences from a rural perspective. More specifically the aims for the studies included were:

1. To assess whether distance by road to hospital has an impact on the following outcomes: stoma reversal rate; time from index operation to stoma reversal; and occurrence of permanent stoma.
2. To investigate the impact of distance by road to the nearest hospital on the QoL of rectal cancer patients who receive a stoma at index surgery.
3. To determine whether prophylactic mesh in a sublay position has an impact on QoL of patients receiving a permanent end colostomy.
4. To enlighten the experiences of living with a stoma in a rural area in northern Sweden. To describe stoma-related problems that occur and how the process of seeking care for these is experienced.

Materials and Methods

Study I

Data from The Swedish Rectal Cancer Register (SRCR) and Statistics Sweden were used. The Swedish Colorectal Cancer Register (SCRCR), includes both colon and rectal cancer patients but each diagnosis is reported separately. The Rectal Cancer Register has been in use since 1995 [73]. For the years 2007-2011 the completeness was 99% and data are considered to be population-based [74]. Statistics Sweden is an agency responsible for official statistics by order of the Government Offices of Sweden [75].

All diagnosed cases of rectal cancer from the 3 most northern counties in Sweden 2007-2014 were extracted from the SRCR. In these counties the absolute majority of tumour resection surgery for rectal cancer was performed at the hospitals in the largest town of each region; Umeå, Östersund and Sunderby. Follow-up as well as stoma reversal, however, could be performed in a smaller hospital in Skellefteå, Lycksele, and Gällivare. The county of Jämtland has only one hospital in Östersund. In Västerbotten, besides the county hospital of Umeå there are two smaller hospitals in Skellefteå and Lycksele. There are five hospitals in Norrbotten. However, only two of these, Gällivare and Sunderby, performed surgical procedures included in this study. The hospitals in Kalix, Piteå and Kiruna do not have a surgical ward.

Register data comprised all diagnosed cases of rectal cancer between 2007 and 2014. Information was found regarding Tumour Node Metastasis classification (TNM), the surgical method used, and if a permanent or defunctioning stoma was created (specified by a yes/no column for each stoma type). When no permanent or temporary defunctioning stoma had been placed in conjunction with HP or APR according to the register this was crossmatched with the surgical notes which were considered to state the true situation. In a similar matter all cases, where registry data stated that no defunctioning stoma was placed in conjunction with AR, a cross match with the surgical notes was performed. In cases where there was palliative intention, creation of a defunctioning or permanent stoma without resection surgery was not included.

As results from a larger study assessing stoma reversal rate reported a median time to stoma reversal around 6 months (191 days) [29], reversals performed beyond 6 months were defined as delayed reversal.

When all defunctioning stomas had been identified, medical records were used in order to gain information about if and when stoma reversal had been performed.

When surgical notes revealed that the defuncting stoma had been converted into a permanent stoma because of complications this was considered to be a permanent stoma and not a temporary one. From the medical record, the address of the patient was also retrieved in order to calculate the road distance to the closest, operating and largest hospital in each region. After receiving approval from Google™, the procedure of calculating distances was performed using Google Maps™.

Socioeconomic variables were also taken into consideration, these variables were extracted from Statistics Sweden and included annual income, level of education, marital status and Swedish/foreign background. These variables were grouped prior to use in the regression models. A non-linear relationship was assumed where the categories lower educated, older and poorer were judged likely to have a different outcome compared to their opposites and these were grouped accordingly.

Since no prior study examining road distance to nearest hospital as a risk factor for non-reversal of a defunctioning stoma, both a linear model and logistic regression were applied. In the latter, both uni- and multivariate regression models were used. In the multivariate model all variables were entered at the same time. The hypothesis was that longer road distance impacted the outcomes negatively.

Studies II and III, EORTC QoL questionnaires

In Studies II and III, questionnaires from the EORTC were used. This independent non-profit research organisation was founded 1962 and has a special interest in long-term follow-up of cancer. They have developed several QoL questionnaires, each one cancer type-specific. In conjunction with these disease-specific questionnaires, a “core” questionnaire assessing general well-being, independent of cancer type, has also been developed [38] . This questionnaire is named QLQ C-30 and comprises a total of 30 questions, all of which are categorised into different scales depending on the affinity among the questions. The questionnaire is divided into *five* functional and *nine* symptom scales. The functional scales include: Physical function (PF); role function (RF); cognitive function (CF); emotional function (EF); and social function (SF). The symptom scales include: fatigue (FA); nausea and vomiting (NV); pain (PA); dyspnoea (DY); insomnia (SL); loss of appetite (AP); constipation (CO); diarrhoea (DI); and financial impact (FI). The questionnaire also includes two questions which together correspond to *one* global QoL measure. Reference material for C-30 from a Swedish population have been published twice and is available for comparison [76, 77].

In the case of colorectal cancer, the first questionnaire to be designed, QLQ CR-38, was developed and published in 1999 [37]. This questionnaire comprises 38 questions which correspond to *four* functional and *eight* symptom scales. The function scales include body image (BI), sexual functioning (SX), sexual enjoyment (SE) and future perspective (FU). The symptom scales include micturition problems (MI), gastrointestinal symptoms (GI), chemotherapy side-effects (CT), defaecation problems (DF), stoma-related problems (STO), male sexual problems (MSX), female sexual problems (FSX) and weight loss (WL).

Ten years after the development of the QLQ CR-38 a short form of the original, the QLQ CR-29, was developed. This questionnaire was validated and published in 2009 [78] and comprises 29 questions that contribute to more scales than in the CR-38; *five* functional scales and *eighteen* symptom scales. The function scales include body image (BI), anxiety (ANX), weight (WEI), sexual interest for men (SEXM) and sexual interest for women (SEXW). The symptom scales include urinary frequency (UF), blood and mucus in stool (BMS), stool frequency (SF), urinary incontinence (UI), dysuria (DY), abdominal pain (AP), buttock pain (BP), bloating (BF), dry mouth (DM), hair loss (HL), taste (TA), flatulence (FL), faecal incontinence (FI), sore skin (SS), embarrassment (EMB), stoma care problems (STO), impotence (IMP) and dyspareunia (DYS).

In both questionnaires, each question is rated by the patients on a scale from 1-4 for each of the functional and symptom questions, while global QoL measure scales range from 1-7. These numbers is then converted into a score from 0-100 according to a scoring manual which has been developed by EORTC [79]. In symptom scales, a high score represents a higher degree of symptoms while a high score in a functional scale or global QoL measure represents a higher degree of functioning or better QoL.

When designing the second study, the short-form QLQ CR-29 had already been developed so this questionnaire was used together with QLQ C-30 in order to assess global QoL. In the Study III, inclusion began in 2007, prior to the development of the CR-29, which is why the original QLQ CR-38 was used to assess QoL. A non-parametric test such as Mann-Whitney-U would seem appropriate for comparison of means, but comparison of means using the independent Student's *t*-test has been validated for EORTC-questionnaires.

Study II

In this cross-sectional study, Västerbotten register data from Study I were used, comprising all rectal cancer patients diagnosed there between 2007 and 2014. Questionnaires were sent to all patients who received a stoma at index surgery, *i.e.* all patients with a permanent stoma, a non-reversed temporary stoma or a

reversed stoma were included. The hypothesis of the study was that patients receiving a stoma after rectal cancer surgery living further away from closest hospital and thus not having access to a specialised stoma nurse would have a poorer QoL. Two separate models were created to illustrate this.

In order to explain the rationale behind these models, the geography of Västerbotten needs to be explained. Västerbotten has three hospitals, two of these are located on the more densely populated coastline and have a specialised stoma nurse and routinely performed colorectal surgery. The third is located in the sparsely populated inland district. It is routine that all patients operated for rectal cancer meet a specialised stoma nurse at the time of index surgery. Patients living inland seldom meet this specialised stoma nurse after discharge, instead they have to rely on the competence present at their catchment hospital or cottage hospital.

At the time of the study the inland hospital lacked routinely performed colorectal surgery. The catchment area of the inland hospital includes six small municipalities and the town were the hospital is localised. The small rural municipalities largely rely on the local cottage hospital for primary healthcare, and distance to nearest hospital therefore constitutes an obstacle to specialised stoma care.

The first model was designed to assess the impact of road distance to the nearest hospital. After studying the map of Västerbotten, the study population was divided into two groups: 1: Those living 76 kilometers or more from the nearest hospital (rural group); and 2: Those living closer than 76 kilometers (control group). In this way, all patients in the rural group lived in small rural municipalities without a hospital while those in the control group had easier access to specialised care. The rationale for using 76 kilometers as the cut-off was that all patients living further away than 76 kilometers lived exclusively in small rural municipalities.

The second model was designed to assess the effect of having access to a stoma care nurse in the county of Västerbotten. Here, the control group comprised patients living in the two coastal cities each with its own hospital and access to a specialised stoma care nurse. Patients from the remaining 13 municipalities, all lacking a specialised stoma care nurse, were assigned to the rural group.

The questionnaires EORTC QLQ C-30 and CR-29 were sent to all patients found eligible. Since ethical permission to perform this study required a written formal consent for participation, analysis of participants found eligible but not willing to participate was not performed.

Study III

In this randomised controlled trial, 232 patients were randomised to either prophylactic synthetic mesh with a central cruciform incision placed in sublay position vs. no such mesh. The purpose of this study was to assess whether prophylactic mesh effects the subsequent QoL of the patient. Data from the one-year follow-up of the STOMAMESH cohort was used. Since both clinical assessment and computed tomography (CT) regarding the presence of PSH were available, a subgroup analysis comparing PSH with no PSH was made. The original publication showed no significant difference regarding PSH diagnosed clinically or by CT [64], and the decision was thus made to use clinical diagnosis rather than CT when dividing the cohort for PSH vs no PSH subgroup analysis.

The questionnaires were answered at the time of a one-year clinical assessment of possible late complications performed by a surgeon blinded to the surgical method used. All responders to these questionnaires were included in the study. The clinical assessment was structured not only to discover PSH but also any other major stoma-related complication and to measure the abdominal circumference in both the supine and upright position. Stoma-related complications are listed in Table 1.

Reference material is available for one of the questionnaires. In the year 2000, Michelson *et al* published material using EORTC QLQ C-30 with over 3000 responders [76]. In this study the questionnaire was sent to a "healthy" part of the population. A similar study was later reproduced by Derogar *et al* in 2012 with close to 5000 responders [77].

Table 1. Complications assessed clinically at 1-year follow-up

Complications assessed
PSH
Bulging only
Partial PSH
Circumferential PSH
Stenosis
Prolapse
Stoma dressing problems

Study IV

Sorsele, Storuman, Malå, Åsele, Dorotea, Vilhelmina and Åsele are six small municipalities in southern Lapland, Sweden, all lacking their own hospital.

Instead, they have a special form of extended primary care called the cottage hospital. From these municipalities, participants were recruited through a purposive sample based on data on prescribed stoma dressing material extracted from the National Board of Health and Welfare. All stoma dressing material is categorised according to a system called the Anatomical Therapeutic Chemical (ATC) classification system. According to one report, there is a total of 14 major ATC-codes covering all stoma dressing materials available at pharmacies in Sweden [11]. Each of these main categories has numerous subcategories categorised into minor ATC-codes. Data on totally 44 different major/minor ATC-codes were requested in order to be certain that all types of stoma would be considered for inclusion.

A question guide was created and thereafter discussed with a stoma nurse prior to the start of the study. The question guide, exclusive of background questions, can be seen to comprises six different themes or clusters of questions about living with a stoma, with follow-up questions under each theme. Two questions have rather specific content and therefore have no follow-up questions (Table 2).

Participants were initially contacted by phone and asked if they would be willing to participate. All data were collected by interviews in person, none by phone. There were no technical problems with recording of interviews and no repeat interview was carried out. The choice of using qualitative content analysis according to Graneheim & Lundman [49], instead of other available qualitative methods was because of its focus on the subject and context. In this case the stoma patient living in a rural area.

Table 2. Question guide

Cluster	Question
Cluster A	Can you tell me what it is like to live with a stoma?
	Describe an ordinary day for you
	What do you like to do?
Cluster B	Has your life changed since you received the stoma?
	How has your life changed?

	Are there any activities that you no longer can or are willing to do after having a stoma? Give examples
	Has the stoma affected the way you act in the social context? How?
	Has the stoma effected your leisure activities or hobbies? How?
	Has the stoma affected the relationship or sexual life with your partner? In which ways? If “yes”, was that something you received information about prior to surgery?
Cluster C	Have you had any problems related to the stoma?
	What was the nature of these problems?
	Do you contact your GP when you have problems related to your stoma? If ”no”, why not?
	Have you ever contacted your local nurse or GP when you have had problems with your stoma?
	Who did you contact when you had problems with your stoma?
	Have you had contact with a stoma care nurse? Where? When?
	Could you attend the university hospital department to have your stoma examined if needed?
	Do you believe you have received proper information regarding your stoma? Give examples
	Do you believe that living in a rural area affects your life with a stoma? Give examples
Cluster D	Can you tell me how you manage your stoma?
	Tell me how you change your stoma bag
Cluster E	Have you experienced that having a stoma effects your everyday life?
	Have you experienced that the stoma affects your self-esteem? Give examples
	Have you experienced that the stoma affects your body image? Give examples

Standalone question	Is there something else that you would like to tell me about your stoma?
Cluster F	Is there anything you believe other people about to get a stoma should know?
	Something you didn't t know when you got your stoma?
	Is there anything you have learned during your time with a stoma that you would like to share with others?
Standalone question	Do you have any suggestions on what could be done to ease the situation for stoma patients living in a rural area?

Statistics

Independent Student's *t*-test is a statistical method that can be used when the outcome i.e. *dependent* variable is continuous and singular. The outcome variable has to meet the assumption of a linear model, *i.e.* normally distributed [80]. If the assumption of a linear model cannot be met, Mann-Whitney-U may be used instead [81]. To be able to apply the *t*-test, the predictor i.e. *independent* variable must be categorical not continuous. Furthermore, for a *t*-test to be feasible, the predictor variable also has to be singular and possess only two categories [80]. If the predictor variable is two or more, or possesses more than two categories, ANOVA may be used to compare means instead [82]. Independent students *t*-test was used to compare outcomes in Studies II and III in this thesis. In Study III, it would seem appropriate to use a different method to better illustrate the impact of distance, *e.g*. logistic regression. Our choice to also use the *t*-test in this study was motivated by the fact that analysis of EORTC questionnaire data using students *t*-test has been validated. Furthermore, by division of the cohort in Study III it was possible to separate the rural population living in small municipalities lacking a hospital, which was in accordance with the aim of the study.

If the outcome variable is categorical, not like the *t*-test, and the predictor variable is singular and categorical, just like the *t*-test, χ^2 can be used [83]. If the predictor variable comprises two or more variables, the various forms of logistic regressions could be better suited for the analysis. χ^2 is robust when dealing with large sample sizes. For small-sized samples, commonly five or less, the Fischer´s exact test is more appropriate [83].

Linear regression analysis assumes a linear relationship of a continuous outcome variable and a categorical or continuous predictor variable [84]. Logistic regression analysis is similar to linear regression analysis, but in this case the

outcome variable is binominal. By applying a logistic model, it becomes possible to study two or more predictor variables using regression analysis [85]. Logistic regression makes it possible to consider two or more predictor variables *simultaneously* in order to predict the outcome variable. This is called multivariate logistic regression analysis. When using a multivariate model, it is important to ensure that all parameters are independent of each other in order to avoid one predictor variable affecting the others and thereby affecting the entire model.

In Study I in this thesis, both linear and logistic regression models were used to assess the relationship between distance to hospital and stoma outcome. The reason for using both methods was that the relationship were previously undetermined. Therefore, both linear distance and distance divided into quartiles could have affected the outcome.

Ethics and ethical approval

There was no risk for physical harm to the patients in studies I, II and IV in this thesis because of their nature. Study III used data from the randomised controlled trial STOMAMESH which has the inherent risk of harm if one of the treatment arms is superior to the other. Thereby there was a risk for physical harm in study III. However, the results of the first publication from this RCT had already been published, showing no difference in complications after one month and no difference in the risk for development of PSH after one-year [64].

The process of gathering information could have been experienced by the patients included as unpleasant. In Studies III and IV all patients included received both verbal and written information regarding the study they were to participate in. Written informed consent was also obtained in all studies except Study I. Patients were able to withdraw from the study at any time, and information already collected deleted. This reduces possible patient discomfort when providing information. Study I was a register-based epidemiologic study and no formal consent were needed for this type of study at the time.

When performing a qualitative study on a population as small as stoma patients in southern Lapland, it is important to bear in mind that some changes may have to be made in order not to reveal personal identity. In such a small population it is easier to trace characteristics back to an individual person than in a large population.

In Study IV, where gathering of information took place after introduction of the General Data Protection Regulation (GDPR), patient information was updated in

accordance with the new regulation. In all other studies the gathering of information took place prior of the GDPR.

Ethical approval:

Studies I, II and IV: Umeå University, (DNR 2016/155-31).

Study III: Umeå University, (DNR 07-081M).

Results

Study I

After exclusion of cases judged not to match the research requirements of this study, 717 of 1021 cases retrieved from the register remained for analysis of patients receiving a permanent stoma after tumour resection at index surgery for rectal cancer. Reasons for exclusion and numbers of cases are listed in Table 3.

Table 3. Reason for exclusion from analysis of occurrence of permanent stoma

Reason for exclusion	Number of cases
Double registration	5
Never treated in the predefined areas	3
No surgical treatment registered	198
Stent only	7
Endoscopic polypectomy	33
Local excision	9
TEM	27
Laparotomy but no resection	22

According to data from the register, a defunctioning stoma was created in 285 cases. According to patient records, twenty of these cases were, were converted to an end-colostomy and therefore not considered to be a defunctioning stoma. Two defunctioning stomas were created with no tumour resection at surgery and were also considered not to be a defunctioning stoma. Through the process of scrutinising patient records, ten defunctioning stomas were found where registry data stated that no defunctioning stoma was performed in conjunction with AR. Altogether, 273 defunctioning stomas remained and analysed for stoma reversal rate. Of these 273 defunctioning stomas 227 (83 %) were reversed, and the median time between index surgery and stoma reversal was 287 days ranging from 82 to 1557 days. Frequency tables of hospitals performing index surgery in the 717 cases of tumour resection surgery possibly involving a permanent stoma and the 273 cases of tumour resection including a defunctioning stoma are shown in Tables 4 and 5 respectively.

Table 4. Frequency table of hospitals performing index surgery possibly involving a permanent stoma

Hospital	n	%
Umeå	277	38.6
Skellefteå	56	7.8
Lycksele	3	0.4
Östersund	126	17.6
Sunderby	246	34.3
Hospital outside region	9	1.3

Table 5. Frequency table of hospitals performing index surgery involving a defunctioning stoma

Hospital	n	%
Umeå	102	37.4
Skellefteå	14	5.1
Lycksele	2	0.7
Östersund	63	23.1
Sunderby	88	32.2
Hospital outside region	4	1.5

In the analysis of the impact of distance on occurrence of permanent stoma at index surgery, it was seen that longer distance did not constitute a risk factor for creation of a permanent stoma when assuming a linear model. Neither could any significant differences be seen when analysing the same outcome in a univariate regression model. Of all cases included, 54 % of the patients received a permanent stoma at index surgery while 38 % received a defunctioning stoma.

When analysing the impact of distance on stoma reversal rate, it was seen that patients living closest to operating hospital (1st quartile) had a reversal rate of 72,7 % while patients living further away (2nd quartile) had a reversal rate of 90%. This difference was significant in a univariate model (OR 0.30; 95% CI 0.12–0.76) but did not remain significant in a multivariate model in which only advanced disease remained a significant risk factor. At follow-up, 46 of the 273 defunctioning stomas still remained and were considered to be non-reversals. In all, 61 % of the

patients still had a stoma at follow-up; 11% non-reversed defunctioning stoma and 89% permanent stoma.

Delayed reversal (> 6 months) was seen in 175 of 227 cases, and reversal beyond 18 months was seen in 17 cases (7 %). When analysing delayed reversals in a linear model, the mean distance to operating hospital was 102 km when reversal was delayed and 66 km when no delay was seen. This difference, however, was not significant in an ANOVA analysis (p=0.07). In the logistic regression model, distance to hospital had no significant impact on delay of reversal.

Study II

Register data were retrieved from SRCR on 462 diagnoses of rectal cancer all of which were considered for inclusion. After exclusion of those who were deceased, never had a stoma, had moved away from the area or were registered twice, 186 patients remained. These patients were sent a letter requesting them to participate in the study together with the two questionnaires, a median of 5.1 years after index surgery. The response rate was 69 % (n=129).

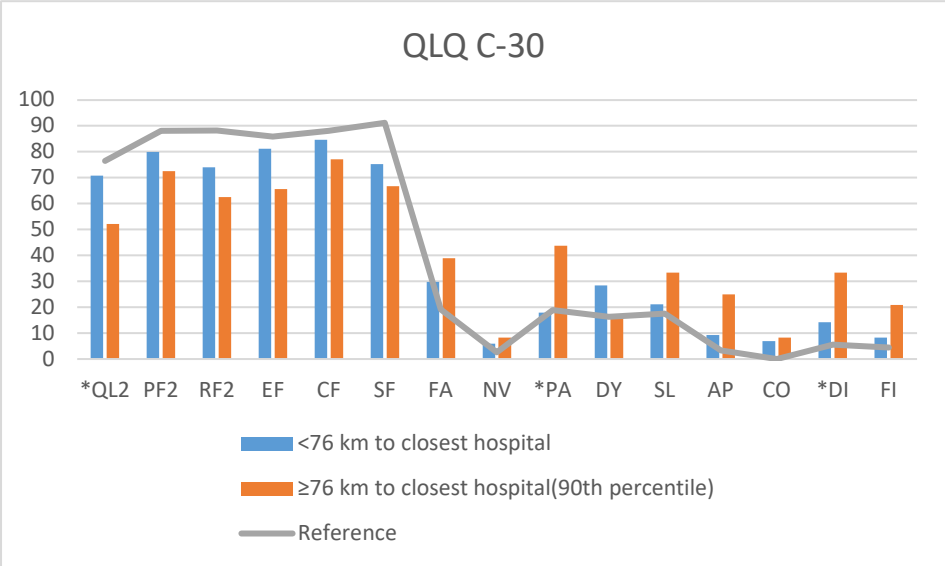
When comparing baseline data using the first model (road distance to hospital <76 km vs. ≥76 km), the proportion of defunctioning stomas that were reversed was higher in patients in the control group compared to the rural group (87% compared to 56% respectively). No other significant difference was seen at baseline. There were 13 responders that lived 76 km or further from the hospital while the number living closer was 116. When comparing mean scores in the answers to the C-30 and CR-29 questionnaires, patients living further away reported more sore skin, more pain and more hair loss. The score difference in favour of patients living closer was 22.9, 15.2 and 13.9 respectively. Five of the responders in the rural group (≥76 km) had had their stoma reversed, while eight still had a stoma.

When comparing baseline data between groups in the second model (access to stoma nurse vs. no access) baseline data were similar in the two groups. A lower percentage of married persons in the group of patients lacking access to a stoma care nurse (55% vs. 74%) was the only difference seen. There were 42 responders who lived in a municipality with no access to a stoma care nurse and 87 living in a town with access. When comparing mean scores of the answers to the C-30 and CR-29, a difference corresponding to that seen in the first model was absent. The only difference seen concerned dry mouth that was reported more in the group of patients living in a municipality with no access to a stoma care nurse (p=0.038).

A subgroup analysis was performed within the first model eliminating non-stoma patients. When analysing the eight patients that still had a stoma, greater

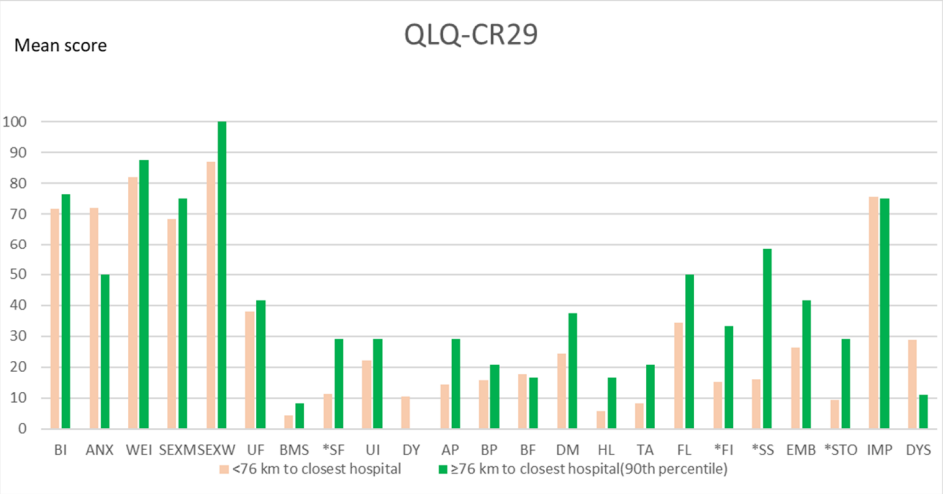
differences were seen than when analysing the entire group. Stoma patients living further away (≥76 km) reported poorer global QoL with a score difference of 18.6 in favour those living closer to the hospital. The same disadvantage for patients living further away was also seen in several stoma-related symptom scores and also for pain. The group of patients living further away reported higher stoma output, more stoma bag leakage, more stoma bag changes, and more stoma-related problems in general, with score differences of 19.1, 18.1, 17.9 and 19.9 respectively. The differences seen in C-30 and CR-29 in this subgroup analysis are shown in Figures 1 and 2. In Figure 1 the Swedish reference population from 2012 has been inserted [77].

Figure 1. Differences in quality-of-life scores using the general QLQ-C30 in stoma patients only



Asterisk indicates p = < 0,05. Linear component constitutes reference population. Living closer than 76 kilometers away from nearest hospital compared to living 76 km or further away. QL2= Global health status/QoL. Function scales: PF2=Physical functioning, RF2=Role functioning, EF=Emotional functioning, CF=Cognitive functioning, SF=Social functioning. Symptom scales: FA=Fatigue, NV=Nausea and vomiting, PA=Pain, Dy=Dyspnoea, SL=Insomnia, AP=Appetite loss, CO=Constipation, DI=Diarrhoea, FI=Financial difficulties

Figure 2. Difference in scores using the colorectal cancer-specific QLQ-CR29 in stoma patients only.



Asterisk indicates p = < 0,05. Living closer than 76 kilometers from nearest hospital compared to living 76 km or further away. In the scale DY=Dysuria, the patients living further away reported no such symptoms, hence 0 in that bar. Functional scales: BI= Body Image, ANX=Anxiety, WEI=Weight, SEXM=Sexual interest(men), SEXW=Sexual interest(women). Symptom scales: UF=Urinary frequency, BMS=Blood and mucus in stool, SF=Stool frequency, UI=Urinary incontinence, DY=Dysuria, AP=Abdominal pain, BP=Buttock pain, BF=Bloating, DM=Dry mouth, HL=Hair loss, TA=Taste, FL=Flatulence, FI=Faecal incontinence, SS=Sore skin, EMB=Embarrassment, STO=Stoma care problems, IMP=Impotence, DYS=Dyspareunia

Study III

A total of 232 patients were randomised to mesh or no mesh. At one-year follow-up, 211 patients remained. Reasons for not participating at the one-year follow-up are listed in Table 6.

Table 6. Reasons for loss to follow-up one year after surgery

Reason for loss of follow-up	n
Refusal to participate	9
Death	7
Surgical complication	3
Dementia	1
Progression of disease	1

Of the 211 patients available at one-year follow-up 63 did not respond to the questionnaires. Finally, 148 patients were included in this study (response rate 70%). Median age was 71 years, 41 % were female. Baseline characteristics are displayed in Table 7.

Table 7. Demographic data for the responders of the QoL questionnaires.

n=148	Non-mesh, n=73	Mesh n=75	p-value
Age, years, range	70(36-88)	71(50-87)	N.S
Male (%)	37(51%)	51(68%)	0.032*
Cancer as indication	64(88%)	70(93%)	
ASA-classification			N.S
ASA 1(n=21)	8(11%)	13(17%)	N.S
ASA 2(n=93)	46(63%)	47(63%)	N.S
ASA 3(n=32)	17(23%)	15(20%)	
missing value	2	0	N.S
BMI, range	26.9(18.5-43.7)	26.2(16.7-37.8)	
missing value	2	1	N.S
Operation time, min, range	292(98-625)	313(70-616)	
missing value	4	5	N.S
Smoker	4(5%)	8(11%)	N.S
missing value	4	4	

Mean values are shown for age, BMI, operation time. When comparing means, *t*-test was employed. When comparing a categorical outcome, χ^2 or Fischer's exact test was employed. The sum of the distribution in ASA-classification in the non-mesh group did not reach 100% because of missing values.

Of the patients included, 14 (9%) had a non-cancer indication for receiving an end-colostomy. A PSH was clinically present in 45 (30%) patients with no significant differences in occurrence between the groups. Nor were there any significant differences among the other stomal complications assessed at the one-year follow-up *i.e.* bulging only, stenosis, prolapse, or stoma dressing problems.

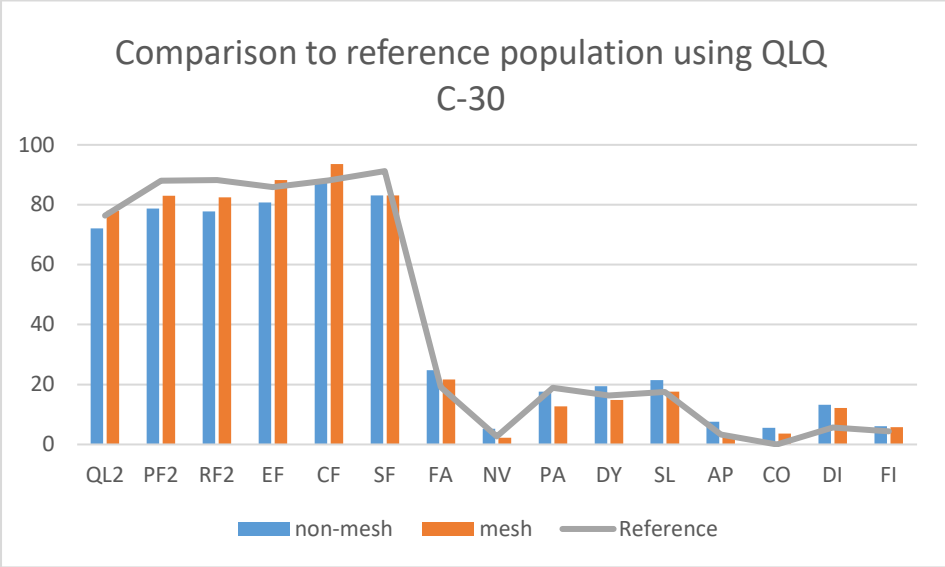
Using the generic instrument QLQ C-30, no significant difference in global QoL between the groups was seen. Mesh patients scored significantly superior in "emotional functioning" and "cognitive functioning", no other significant differences were seen. Score differences in favour of mesh patients were 7.5 ($p = 0.025$) in "emotional functioning" and 5.9 in "cognitive functioning" ($p = 0.015$). These differences remained significant after excluding those with a clinically diagnosed PSH ($n = 45$).

Using the colorectal cancer-specific instrument QLQ CR-38, patients receiving a mesh had significantly *less* stoma-related problems, with a score difference in favour of mesh patients of 8.4 ($p = 0.014$). This difference remained significant after excluding patients with a clinically diagnosed PSH. Responders in the mesh group also reported *more* sexual problems in males (difference 17.4, $p = 0.022$). No significant differences were seen in the scales answered by both sexes regarding sexual enjoyment and sexual functioning.

A subgroup analysis based on the presence or absence of a clinically diagnosed PSH was performed ($n = 45$ vs. 105). When comparing scores from both questionnaires the PSH group reported significantly more constipation, with a score difference of 6.3 ($p = 0.023$). No other significant differences were seen for QLQ C-30 and CR-38.

A graphic comparison of questionnaire scores of responders according to mesh or no mesh and the "normal" Swedish population from 2012 [77] is presented in Figure 3.

Figure 3. Differences in quality-of-life scores using the general QLQ-C30 according to mesh or no mesh



Linear component constitutes reference population QL2= Global health status/QoL. Function scales: PF2=Physical functioning, RF2=Role functioning, EF=Emotional functioning, CF=Cognitive functioning, SF=Social functioning. Symptom scales: FA=Fatigue, NV=Nausea and vomiting, PA=Pain, Dy=Dyspnoea, SL=Insomnia, AP=Appetite loss, CO=Constipation, DI=Diarrhoea, FI=Financial difficulties

Study IV

Twenty-one persons were contacted by phone. Of these, 17 accepted participation and gave consent. Eight of the participants were females and nine males. The median distance to nearest hospital was 110 km (range 55 – 250 km). All participants lived at home and none in nursing home facilities. Eleven were married or had a relationship. Participants from all six rural municipalities available were included. The median time the participants had had a stoma at the time of the interview was 12 years (range 5 – 43 years). Nine of the participants had a colostomy, seven a urostomy and three an ileostomy. Two patients had both a colostomy and a urostomy. After 13 interviews no new information was retrieved. After discussion among the authors, a choice was made to include four further patients to be certain that no information was missed, and that saturation had been reached.

Three main categories were abstracted from the data: 1. Living with a stoma is experienced as a learning process, and acceptance of its existence is crucial; 2. Varying experiences of contact with the healthcare system and 3. Experiencing problems related to the stoma is common and affects the everyday life negatively. In each category, three to four subcategories were found. Categories with corresponding subcategories are listed in table 8.

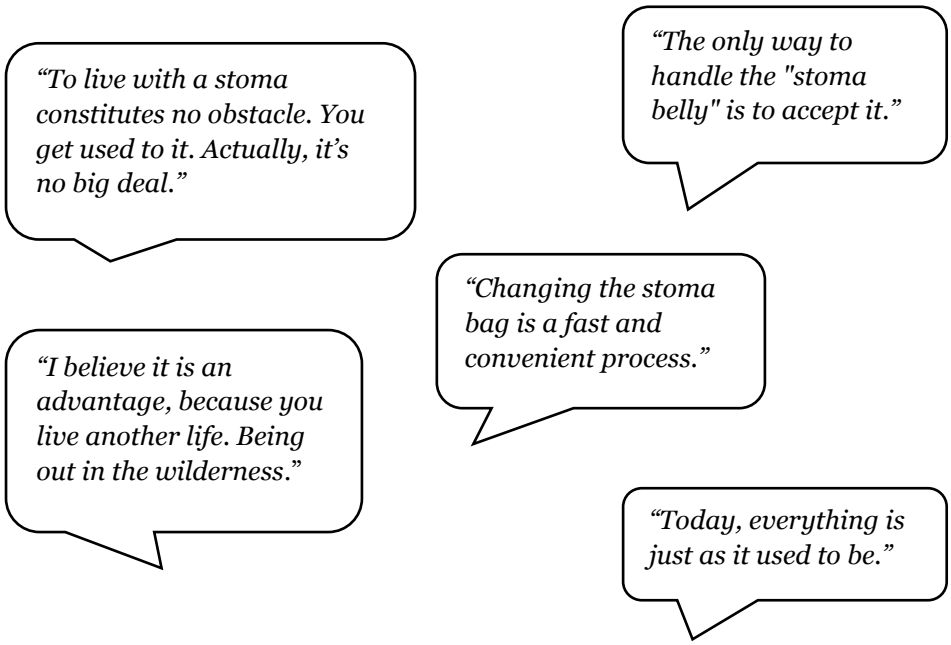
Table 8. The three main categories with corresponding subcategories in the column below.

Category	Living with a stoma is experienced as a learning process, and acceptance of its existence is crucial	Varying experiences of contact with the healthcare system	Experiencing problems related to the stoma is common and affects the everyday life negatively
	Having a stoma leads to an inevitable change in life	Experience of inequality	A lack of understanding amongst the general population
	The importance of leisure activities and hobbies	Experience of lack of resources and competence regarding stoma-related problems	Stoma-related symptoms are varied, unpredictable and often persistent
	The belief that a stoma does not prevent living a normal life	Positive experiences of the healthcare system	An undeniable obstacle to many personal, social and leisure activities
	Being convinced that the stoma has led to a positive change in life		

Living with a stoma is experienced as a learning process, and acceptance of its existence is crucial:

Practically all informants acknowledged and described life with a stoma as being a process. Leakage and problems with bandaging were described as causing an *inevitable change in life*. This change in life varied among the participants depending on the amount of time that stoma care, described and experienced by all as a meticulous process, took each day. Participants initially experienced their stoma as something unnatural, and by some as affecting both self-esteem and body image negatively. Participants frequently described how happy they were to be able to *practise activities and hobbies* that mattered to them, this was seen as something important and led to the view that *their stoma was not an obstruction to living a normal life*. Some participants saw their stoma as a symbol - that they had defeated their disease. No longer having to endure symptoms of IBD or cancer was experienced by some that their *stoma had led to a positive change in life*.

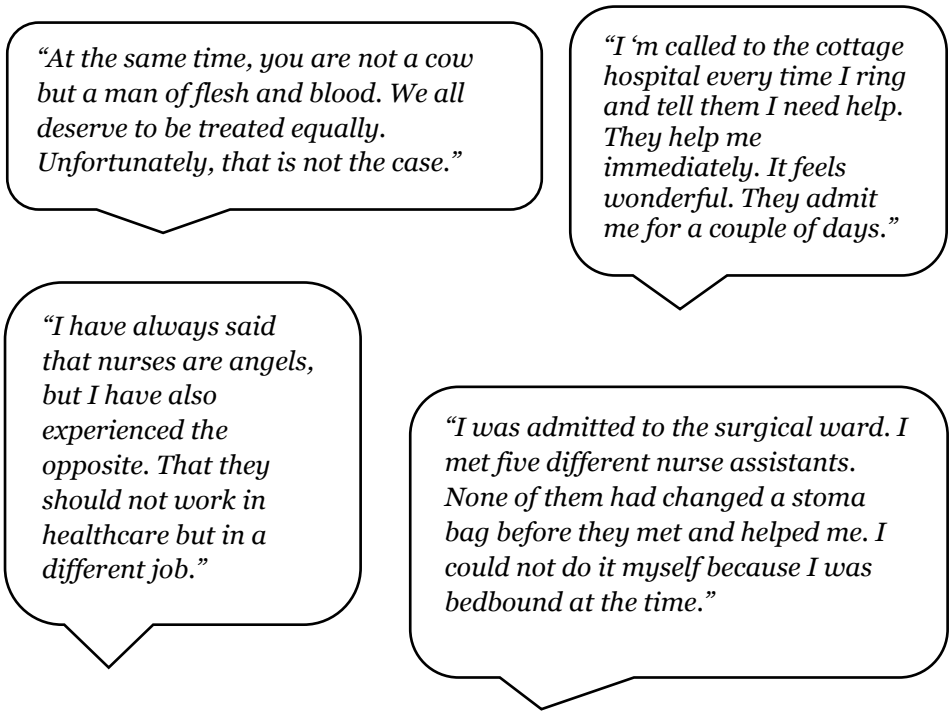
Figure 4. Examples of quotations from the first category and subcategories



Varying experiences of contact with the healthcare system:

The cottage hospital was by close to all participants their initial way of coming in contact with the healthcare system for stoma-related problems. Some described trust and satisfaction with the care provided at the cottage hospital, while others expressed dejection. The process of ordering stoma dressing material was perceived as unjust, and getting proper help was perceived as complicated. Participants perceived *inequality of care* compared to people living in urban areas and other patient categories. Inadequate knowledge in stoma-related problems and lack of physician continuity in primary care was experienced by those participants who were dissatisfied the service provided at the cottage hospital. While some experienced *lack of resources and competence in stoma-related problems* others spoke warmly of their cottage hospital. Some participants described a p*ositive experience* of the 24-hour availability of care at the cottage hospital and the security this provided. In answer to the question on distance to nearest hospital, all participants assumed the distance to their cottage hospital, never the distance to Lycksele or Umeå.

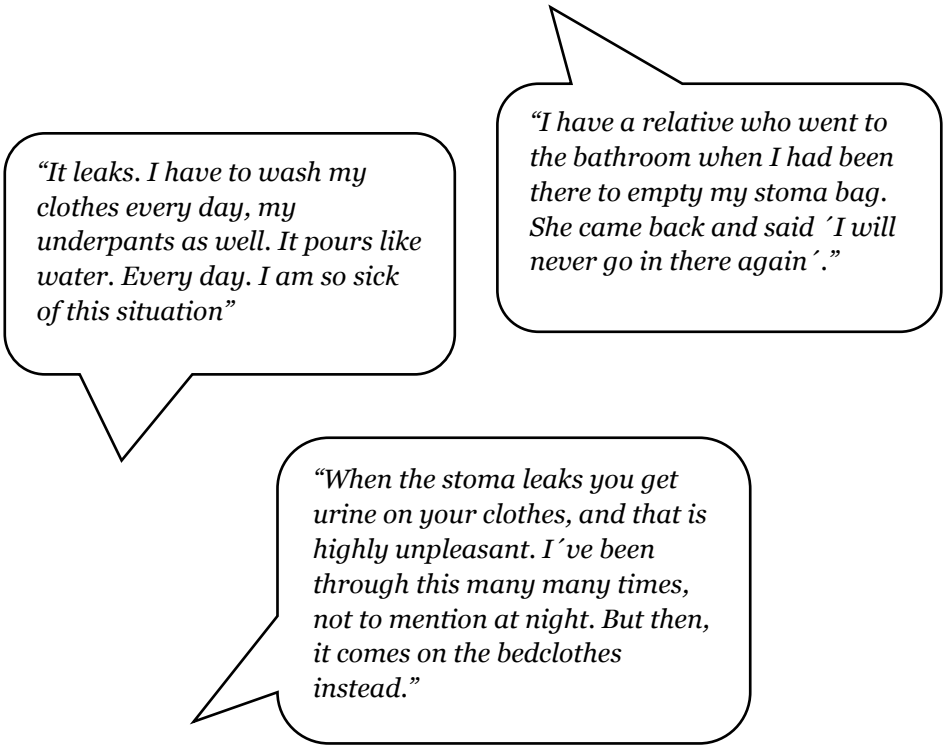
Figure 5. Examples of quotations from the second category and subcategories.



Experiencing problems related to the stoma is common and affects the everyday life negatively:

Practically every informant felt that stoma-related problems affected their everyday life to some degree. Many described a panorama of varied and unpredictable symptoms. *A lack of understanding* and rude behaviour from other people, and even, in some cases, relatives, made matters worse. Stoma leakage was commonly experienced. In some cases, this was caused by a parastomal hernia and was predictable in certain situations, but in others it was experienced as something highly *unpredictable*. These commonly occurring symptoms often were perceived as an *obstacle to personal, social and leisure activities*. Avoidance of sauna and bathing, for instance, was frequently mentioned.

Figure 6. Examples of quotations from the third category and subcategories



Discussion and future aspects

The likelihood of having to live with a non-reversed defunctioning stoma after AR for rectal cancer is not greater when living further away from hospital. However, results from Study I in this thesis indicate that you might have to wait longer for reversal. Even if the reversal procedure is associated with complications [86-88], stoma-related problems can disappear when reversed. For patients whose stoma is not reversed but remains unintentionally permanent, stoma-related problems can become lifelong. Non-reversal of a defunctioning stoma is generally not considered to be a stoma-related complication, even if it causes lifelong stoma-related problems for the individual patient. Studies evaluating stoma reversal rate and time to stoma reversal have been conducted previously, but distance to hospital has never been studied as a risk factor for delayed or non-reversal of a defunctioning stoma.

The most surprising finding in Study I was the length of time waiting for stoma reversal. The median time to stoma reversal was 287 days with some patients waiting as long as 4.3 years after index surgery (range 82–1557 days). Compared to the results of a similar study conducted a few years ago, a negative trend is seen where patients have to wait longer for their stoma reversal [28]. Floodeen *et al* reported that 58 % of the reasons for delayed reversal were not healthcare related and concluded that low medical priority was the contributing reason for delaying the procedure [28]. In the light of these results, it important for us to understand the implications this prolonged delay has for the individual patient. In many cases these patients have to endure the side-effects of a defunctioning stoma such as dehydration, which often requires hospital admission [14]. Furthermore, comparison with studies from Europe and the rest of the world shows that the time waiting for stoma reversal is markedly longer in northern Sweden [89, 90]. There is no uniform recommendation as to when a defunctioning stoma should be reversed, but 8-12 weeks is generally recommended, and this is also the case in Västerbotten. When considering a reversal procedure, one must ensure sufficient time for healing of the anastomosis and balance this against stoma-related problems such as the previously mentioned risk for dehydration and patient discomfort. After a median of 12 years follow-up, Gadan *et al* showed that a defunctioning stoma is associated with an negative effect on anal function compared to patients not receiving a defunctioning stoma after anterior resection for rectal cancer [91]. If a defunctioning stoma leads to impaired anal function, it is probable that delayed reversal would accentuate this problem. Another aspect is that the aboral part of the bowel distal to the defunctioning stoma remains largely unused and is thus likely to lose some of its motor function. Studies assessing this are lacking, but if shown to be the case this would strengthen the

indication for timely reversal. Postoperative adjuvant chemotherapy could of course be a reason prolonged delay but is definitely not the major cause.

A possible reason for the increase in waiting time is the introduction of national accelerated cancer care programmes in Sweden. A report from the Swedish National Board of Health and Welfare describes signs of crowding displacement of benign surgery [92]. Chand *et al* described a possible solution to this problem whereby a patient contract is agreed scheduling a date for stoma reversal at the time of discharge after index surgery [93]. In this way the stoma reversal procedure may be seen as an integral part of rectal cancer surgical treatment, not as benign surgery with a low medical priority. Early stoma closure within 8-13 days of index surgery is another alternative, and this has been shown to be safe in selected patients [94]. In contrast to the long-time waiting for reversal seen in this study, the overall reversal rate of 83% found in Study I is normal to slightly higher than reported in other studies [29, 90]. Even if the reversal rate can be considered adequate compared to other studies, it is important to recognise that approximately one in five patients receives an unintentional permanent stoma. This fact prompts discussion regarding stoma function and choice of defunctioning procedure. In northern Sweden, the dominating method for faecal diversion is loop ileostomy [25]. Since faecal matter from an ileostomy is looser than from a colostomy, and therefore more difficult to handle, one could argue of an increased use of a loop colostomy. A meta-analysis comparing loop- colostomy with ileostomy showed that a loop ileostomy is less likely to develop stomal prolapse but has a higher risk for dehydration [95]. The finding of increased risk for dehydration with a loop ileostomy was further supported in a Swedish study [14]. The latest Cochrane review comparing loop colostomy and loop ileostomy concludes there is no evidence in favour of either, but also recognised the increased risk for stomal prolapse with a colostomy [96]. Logically, the larger defect in the abdominal wall required for a colostomy compared to an ileostomy could also increase the risk for stoma site hernia after reversal. This has indeed been seen in a study on risk factors for stoma site hernia [97]. Further studies regarding the optimal defunctioning technique are needed.

In conclusion, Study I showed that living in a rural area does not have a negative impact on the stoma reversal rates. Instead, the findings point to a regional problem in northern Sweden with generally long times waiting for reversal of defunctioning stoma after anterior resection for rectal cancer.

Results from Study II showed that patients who lived in a rural area and had received a stoma after rectal cancer reported significantly more pain, sore skin and hair loss compared to patients not living in a rural area. When analysing the results from the entire group regarding the primary outcome, global QoL, no significant differences were seen using the first model. The differences in score

seen using the first model for sore skin (22.9), for pain (15.2) and for hair loss (13.9), were clinically significant [98]. Using the second model, those living in a rural area without access to stoma care reported a higher dry mouth score, possibly due to dehydration, a symptom commonly seen when having an ileostomy [14].

To stress the magnitude of the differences seen, comparison can be made with another study by Tsunoda *et al* also assessing QoL after rectal cancer surgery and stoma reversal using the same questionnaires. The two scales giving the largest differences when comparing QoL prior to index surgery and two months postoperatively were anxiety and future perspective [99]. On the anxiety scale, the score decreased two months after surgery while on the future perspective scale an increase in score was seen. Comparing their results with ours, the decrease in sore skin in our study was larger than the decrease in anxiety and the increase in future perspective score was slightly less. A decrease in anxiety and an increase in future perspective two months after index surgery is easy to understand given the uncertainty of an untreated cancer diagnosis.

When considering the results from patients in the first model who still had a stoma, further significant differences were found. These stoma patients living in rural areas reported higher pain and sore skin scores, and also an inferior global quality-of-life and higher stoma output in the QLQ C-30. In the QLQ CR-29 responses, more stoma bag leakage and more stoma bag changes were reported by stoma patients living in rural areas. This suggests that until their stoma is reversed after rectal cancer surgery, rural patients experience considerably poorer QoL in many scales. Furthermore, global QoL is also affected negatively if the stoma is present but not when it has been reversed. These results need addressing in future studies on this subject, otherwise there is a risk that the problems affecting rectal cancer patients who still have a stoma and live in a rural area are overshadowed by the better situation of those who have undergone reversal. A stoma patient's capacity to absorb nutrition is largely dependent on the length of intestine distal to the stoma, and this may well be a contributing factor to the difference seen in hair loss, a common symptom of many forms of nutritional deficiency [100].

Reversal of a defunctioning stoma after rectal cancer often has an effect on bowel function. The collection of symptoms occurring after restoration of the bowel's continuity following stoma reversal with resection of the rectum and it´s reservoir function is called the low anterior resection syndrome (LARS). Symptoms commonly include urgency, faecal incontinence and increased stool frequency [101]. This problem is not trivial; a recent meta-analysis estimated the prevalence to be 41 %(CI 24-48) [102]. LARS and stoma-related problems have a considerable and negative impact on global QoL. In Study II, larger differences in

QoL scales were seen when analysing stoma patients only. This suggests that, at least in this rural population in northern Sweden, stoma- related problems affect QoL more than restoring bowel continuity and risking LARS. Data regarding presence or absence of LARS in those who had had their stoma reversed are not available, and the differences reported here must therefore be interpreted with this reservation.

In this study, almost all differences in QoL scales were seen using the first model and not in the second (access to stoma nurse vs. no such access). This could well be interpreted that distance to nearest hospital is more negative than the positive effect of having access to a stoma care nurse. However, another factor that could have contributed to the minimal differences seen in the second model is the presence of the third hospital located inland. Even though this hospital did not have a colorectal surgeon and a specially trained stoma nurse at the time of the study, there were experienced general surgeons. Since patients living in the municipality where this hospital is located were included in the group with no access to a stoma care nurse, it is possible that the positive effect of being close to that hospital influenced results by reducing any possible differences.

Our choice to divide the study cohort into two groups and to use independent Student's *t*-test to illustrate differences instead of, for example, a regression model, was motivated by the fact that EORTC questionnaires are validated for this method (*t*-test). A weakness of this study is the relatively low sample size which increases the possibility of type II errors. It also makes it hard to substantiate any conclusions made regarding the parameters that showed no difference between the groups. However, the differences noted between the groups were adequately significant to reject the null hypothesis. The differences found are also questionable in view of the number of statistical tests required to examine the differences between the groups for the various parameters included in the EORTC modules, increasing the likelihood of type I error. However, the fact that all differences found indicated a disadvantage for patients farther living further away (≥76 km) suggests that the differences were true.

One result that is important to discuss is that the difference in pain scores seen in the C-30 were not reflected by the abdominal pain (AP) and buttock pain (BP) scores in the CR-29. Given the markedly inferior scores for stoma-related parameters reported by patients living further away from the nearest hospital, it seems likely that the pain reported originated from the stoma given the accentuated problems related to having a stoma.

The reason for the increased severity of symptoms suffered by those living further away is difficult to explain, but there is definitely a geographical disparity.

Parastomal hernia is a common complication where the burden of symptoms affects the patient considerably [18].

Contrary to previous results, a recent study showed that placement of a prophylactic mesh at index surgery does not reduce the incidence of PSH after one year [64]. Further analysis with QoL as outcome would be an important adjunct to these findings and could shed more light on aspects of this debated subject (mesh or not).

In Study III, we included 148 responders using the EORTC QLQ C-30 and CR-38 to assess whether a prophylactic synthetic mesh in the sublay position has an impact on the quality of life of patients receiving an end-colostomy. No significant differences in global QoL could be seen. A significant overweight of male responders was seen in the mesh group. A similar numerical difference was seen in the original publication, but in that study this was not significant [64]. When analysing results from the colorectal cancer instrument, QLQ CR-38, a difference in male sexual problems was seen, to the disadvantage of mesh patients. Perhaps report bias could account for this overweight of male responders, since males in the mesh group were keen to answer the questionnaires because of their sexual problem.

Only 14 (9%) of all patients included had a non-cancer diagnosis as the reason for their end-colostomy. This justify our use of the EORTC questionnaires, which are cancer-specific instruments. Other studies assessing QoL after prophylactic mesh placement have not used the EORTC instruments. Brandsma *et al,* who included 150 patients in their study, used SF-36 and Von Korff's questionnaire for grading the severity of chronic pain after three months (Von Korff´s) and one year postoperatively (Von Korff´s and SF-36) [103, 41]. They found no differences in QoL scores between mesh and no mesh. Fleshman's study on stoma QoL included 113 patients and used a stoma-specific instrument, stoma QoL. No significant differences between groups were found in the 24-month follow-up [40].

Otherwise, the results of Study III were in favour of those patients with a mesh. All QoL differences in favour of mesh remained significant after excluding patients with a clinically diagnosed PSH. Given that all but one of the significant differences seen in this study pointed in favour of mesh makes it unlikely that a type I error lay behind these findings. If that had been the case, a more even distribution of differences between groups would have existed. Interestingly no difference in PSH or any of the other stomal complications assessed was seen between groups, a factor that otherwise could have been the explanation of these results. It is possible that prophylactic mesh leads to smaller sized PSH compared to no mesh, and therefore less symptoms, even if a smaller hernia has increased

risk for incarceration. This possibility could not be investigated in this study since no such data were available.

The great likeness of the graphic representation of QLQ C-30 results in the Swedish reference population from 2012 [77] supports the validity of this study. Several of the functional and symptom scales, however, showed inferior results in the stoma patient group regardless of mesh or no mesh. That stoma patients have lower scores in several QoL parameters compared to non-stoma patients has previously been reported [54]. QoL is an important outcome that must be taken into consideration in all forms of healthcare.

The conclusion of this study does not differ from that of Study II where stoma patients living in a rural area reported inferior QoL compared to urban patients. Therefore, our evaluation of ways to prevent PSH has a role in this thesis even if the study lacks a rural focus. It may well be that prevention of PSH has even greater significance for the patient living in a rural area given the lack of nursing and surgical competence. Since Study II, despite its small sample size, showed poorer QoL and more stoma-related problems amongst patients in rural areas, we felt it important to assess whether a mesh could counteract these stoma-related problems, even if the index study showed no effect on PSH development.

Qualitative studies often require smaller sample sizes because saturation of data is usually reached after a relatively low number of inclusions compared to quantitative studies. Study IV investigated how patients living in a rural area experienced living with a stoma.

Results from Study IV show that when living in a rural area, having a stoma amounts to an abrupt change in life. Some described an inferior body image and self-esteem compared to prior to stoma surgery, this effect on body image is in accordance with previous qualitative findings [104]. When participants with time learned how to properly manage their stoma, life became easier, and they described how essential acceptance of their situation was. Previous articles have also highlighted this adaptation with time [105, 106]. In a publication by Fleshman *et al*, of a randomized controlled trial with QoL follow-up of stoma patients Days 7 and 30, Months 6, 12 and 24 [40] the same pattern was seen.

Many expressed that still being able to ski, drive a snow mobile, hunt and spend time in nature convinced them that having a stoma was no obstacle. The importance of being able to cope and adapt to the new situation with a stoma has been reported in other qualitative studies [107]. An example of the difficulties entailed during adaptation was described by one participant who suffered unpredictable stoma leakage when working in the forest wintertime with no running water available.

This stoma adaptation process may be explained by Maurice Merleau-Ponty´s theory of body-subject. The rationale behind this theory lies in the proposition that the body lacks the ability of being purely an object, instead the body exists from *my own view* [108]. His theory is often exemplified in that a blind man´s stick changes his perception of the world rather than being a wooden object. In the same manner, a transplanted organ or a stoma changes one's perception of the body. Recognition of this change could very well correspond to the need for acceptance described by the participants, thus explaining the results of this study. Obscuration of the distinction between subject and object, with roots in Merleau-Ponty´s theory, has recently been further developed in the form of *postphenomenology* [109]. With the increase need to explain the relationship between the human and technology in recent decades, postphenomenology takes Merleau-Ponty´s theory one step further. In line with his theory, perception of the body is plastic, but objects *transform* our experiences [109]. This transformation is exemplified by Maslow´s quotation " If all you have is a hammer everything looks like a nail" [110].

The varied experiences of healthcare amongst the participants in Study IV was striking. Some had met the same primary care physician for decades and were more than pleased with his or her treatment, while others expressed dejection over nonchalant behaviour from both physicians and nurses. The importance of proper intervention and comprehension of stoma accessories by nurses has been stressed in the literature [111]. The lack of continuity in primary care was a recurrent theme - having to explain one's medical history over and over again to strange physicians was a strain on the patience of participants. Recent studies have shown this lack of continuity to have a considerable effect, even on mortality [72]. In some cases, participants described that the care provider's knowledge regarding stoma-related problems left much to be desired. The few participants who had regular contact with a specialised stoma nurse were generally very pleased. This positive experience of stoma care nurses was seen in a previous study [112].

In many respects, complaints from the participants were neither hard to understand nor hard to fix. One participant described how, when ordering stoma equipment, he was obliged to go via the 1177 webpage (a national service provided by the public healthcare system in Sweden) and fill in each order by hand, while his partner who suffered from diabetes used a prefilled template. This demonstrates how simple problems can be solved, easing the situation for stoma patients.

Is it possible that improved collaboration between primary and specialised care could solve many of the problems described by the participants? The implementation of e-health solutions to improve access to a stoma care nurse or

a surgeon, for example, would increase the continuity for the patient while increasing know-how in primary care. Other E-health projects recently launched in primary care in this very same region have been shown to be feasible [113, 114].

The raison d'être of this thesis is to shed light on how the principle is upheld: that people living in a rural area in northern Sweden should have equally good healthcare as people living in cities with a large hospital. Diagnosis of stoma-related problems is mostly based on CT scan or in some cases intrastomal ultrasound, both of which do not exist in rural cottage hospitals. Development of a simplified examination method could act as a bridge between specialists at the larger hospitals and GPs at the cottage hospital. Collaboration between Umeå University and Luleå Technical University is currently underway to develop such method. The goal is to develop an ultrasound device that could be placed on a finger while examining the stoma. Ultimately, it is hoped the sensor will have such a thin construction that a combination of palpation with sensory input and 2-D ultrasound imaging may be achieved. Since the technology would be downsised, it may be possible to use it in both the cottage hospital and in a virtual health room close to the patient's home [114]. In the future, this form of examination could lead to a more rapid diagnosis for patients with stoma-related problems in rural areas. The combination of digital examination through palpation and ultrasound imaging would certainly have applications in other fields of medicine.

Surgical practice has advanced considerably since the first reported stomas in the beginning of the 18th century, but this thesis has shown that the present situation regarding stoma care leaves much to be desired. Results from Study I show that nearly four out of five of the patients receiving a defunctioning stoma in conjunction with rectal cancer surgery, in northern Sweden, have to wait more than six months for reversal. That study was based on data from 2007-2014 and naturally leads one to speculate on how the situation is today. Contrary to the hypothesis of the study, longer travelling distance to the nearest hospital did not have a negative impact on stoma reversal and occurrence of permanent stoma. Indeed, the opposite relationship was seen in the univariate analysis. We believe these results reflect the fact that smaller hospitals take responsibility for follow-up after AR for rectal cancer, leading to higher stoma reversal rates. In towns with larger hospitals, patients with a defunctioning stoma may not be prioritised and reversal rates suffer. Results from Study II showed that patients living in rural areas, who receive a stoma at index surgery for rectal cancer, have lower scores in several QoL scales compared to those living in towns with a hospital. Patients who still had a stoma, had lower scores in even more QoL scales, particularly those related to stoma problems. QoL is an important outcome and must be taken into consideration when assessing healthcare if we are to give the best possible service to our patients. Since the most common stoma-related complication is PSH [12],

ways to either prevent or treat this complication is a field of research that should be given highest priority. Results from Study III showed that prophylactic synthetic mesh in the sublay position does not improve global QoL after stoma surgery when compared to no mesh, suggesting that the search must go on to find an effective means of preventing stoma-related complications such as PSH. The absence of effective treatment implies that many patients are forced to live with their stoma-related problems. Results from Study IV support this view. Results from this qualitative study showed that living with a stoma in a rural area is experienced as a process leading to acceptance of the situation, and that this is crucial. In rural areas, where specialised stoma care is absent, how patients experience local healthcare varies considerably. Increased more effective collaboration between specialists and local practitioners together with new e-solutions is encouraged and could improve the situation for patients with stoma-related problems living in rural areas. However, for this to work it is essential to maintain the foundations of primary care in the rural setting *i.e.* availability, continuity and knowledge of the patient's family and social network.

Conclusions

- Longer road distance is not a risk factor for non-reversal of a defunctioning stoma or occurrence of permanent stoma after tumour resection surgery for rectal cancer. In fact, using a univariate regression model, the opposite was seen; those living closest to the operating hospital had a higher non-reversal rate. In a linear regression analysis, a clear trend was seen where those having their reversal delayed lived further away from the operating hospital compared to those with no delay.

- Of all stoma reversals performed in northern Sweden 2007-2014, 77% were delayed, indicating this to be a regional problem probably due to low medical priority.

- Rectal cancer patients receiving a stoma at index surgery who live in a rural area far away from the nearest hospital experience a similar QoL to those living nearby. However, rural patients report more pain and sore skin. When excluding those who had had their stoma reversed, patients living in rural areas further from hospital reported poorer QoL and more stoma-related problems. Poor access to a specialised stoma care nurse did not explain the differences seen.

- Prophylactic synthetic mesh in the sublay position does not improve global QoL one year after forming an end-colostomy. However, patients

with a mesh reported less stoma-related problems compared to those without.

- Living with a stoma in rural areas in northern Sweden is experienced as a process where the acceptance of the stoma is described as crucial. Problems related to the stoma were common and considered by many as being a constant threat to personal freedom.

- Despite previous research showing its advantages, continuity in primary care is sadly lacking in rural areas in northern Sweden and was frequently described as a problem by stoma patients in this study. Increased cooperation between primary healthcare physicians and specialised stoma units is encouraged in order to improve the situation for these patients.

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