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Study protocol for investigating racial disparities in pain care: a comprehensive integration of patient-level and provider-level mechanisms with dyadic communication processes using a mixed-methods research design

Nao Hagiwara ,[1] Emily Rivet,[2] Brian A Eiler,[3] Christen Edwards,[4] Nadia Harika,[5] Shawn C T Jones,[6] Amelia C Grover,[2] Peter Mende-Siedlecki[7]

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For numbered affiliations see end of article.

Correspondence to
Professor Nao Hagiwara; nh6ty@virginia.edu

ABSTRACT

Introduction Although many efforts have been made to reduce racial pain disparities over decades, the pain of black patients is still undertreated. Previous work has identified a host of patient and provider factors that contribute to racial disparities in healthcare in general, and consequently, may contribute to disparities in pain care in particular. That said, there has been limited clinically meaningful progress in eliminating these disparities. This lack of progress is likely because prior research has investigated the influence of patient and provider factors in isolation, rather than examining their interaction. Successful pain care requires constructive patient-provider communication, and constructive communication is both dyadic and dynamic. One well-accepted operationalisation of such dyadic processes is behavioural coordination. We hypothesise that the pain of black patients continues to be undertreated because black patients are more likely than white patients to participate in racially discordant medical interactions (ie, seeing other-race providers) and experience disruptions in behavioural coordination. We further hypothesise that disruptions in behavioural coordination will reflect patient and provider factors identified in prior research. We propose to test these hypotheses in the planned surgical context.

Methods and analysis Using a convergent mixed methods research design, we will collect data from at least 15 surgeons and their 150 patients (approximately equal number of black and white patients per surgeon). The data sources will include one surgeon survey, four patient surveys, video- and/or audio-recordings of preoperative consultations and medical chart reviews. The recorded preoperative consultations will be analysed both qualitatively and quantitatively to assess the magnitude and pattern of behavioural coordination between patients and surgeons. Those data will be linked to survey data and data from medical chart reviews to test our hypotheses.

Ethics and dissemination Ethical approval has been obtained from the Virginia Commonwealth University Institutional Review Board (HM20023574). Findings will be disseminated through presentations at scientific conferences, publications in peer-reviewed journals and speaking engagements with clinician stakeholders. We will also share the main findings from this project with patients via a newsletter on completion of the entire project.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This research examines the role of dyadic and dynamic communication processes, specifically behavioural coordination, in influencing patient/provider factors and racial disparities in pain care and outcomes.
⇒ This study uses a convergent mixed methods research design to comprehensively analyse the nature of behavioural coordination during preoperative consultations.
⇒ We will use cross-recurrence quantification analysis to quantify the magnitude of coordination between the patient and surgeon at the non-verbal, paraverbal and verbal behavioural levels.
⇒ We will code transcribed preoperative consultations to analyse the context of behavioural coordination.

INTRODUCTION

Racial disparities in pain care have broad and deep consequences for patients' lives. Untreated and persistent pain is a robust predictor of a diminished quality of life,[1–4] including, but not limited to, higher risk of experiencing depression and anxiety,[4–7] challenges in resuming work[8 9] and increased healthcare demands and burdens.[9–11] Although many efforts have been made to reduce racial pain disparities over decades,[12 13] the pain of black patients is still undertreated. For example, a recent meta-analysis on the treatment of acute pain in emergency departments from 1990 to 2018

demonstrates that black patients were at least 60% less likely than white patients to receive analgesia.[14] Furthermore, racial disparities exist across care stages (ie, pain assessment, treatment and management), contexts (eg, from the emergency room to postoperative care) and pain types (eg, acute, chronic, cancer),[15] controlling for age, gender and pain intensity.[16]

Prior research, including our work, has identified both patient factors (eg, medical mistrust, perceived discrimination)[17–24] and provider factors (eg, implicit prejudice, explicit stereotyping, pain perception bias)[25–30] fuelling racial disparities in healthcare in general, and thus likely contributing to disparities in pain care in particular. In spite of the comprehensive catalogue of patient and provider factors examined in this literature, there has been limited clinically meaningful progress in reducing these disparities. We argue that this is mainly because of the fragmented approach that is typically employed within this literature, where individual-level factors predicting racial disparities in pain care are identified in isolation. This approach has grossly limited our ability to gain a comprehensive understanding of racial pain care disparities.[31]

According to widely used frameworks like the Social Communication Model of pain, interpersonal processes are fundamental to how people experience and express pain.[32 33] Therefore, decisions regarding pain care are not made by a patient or a provider independently; they are a unilateral process. This suggests successful pain care requires constructive patient-provider communication, which is characterised as both dyadic and dynamic. Specifically, patients express their pain-related concerns, providers interpret patients' pain experience and respond accordingly and this ongoing exchange lasts until they reach a mutual agreement about the optimal approach to pain management for the patient. Based on these premises, we developed a conceptual model that underscores these dyadic and dynamic communication processes as the crucial factor underlying the racial disparities in pain care and pain outcomes (figure 1). [31]

Our conceptual model[31] posits that patient and provider factors predict patients' and providers' communication behaviours, respectively (Paths A and B). Our model diverts from prior research here and highlights the mutual influences between patients' and providers' communication behaviours (Path C). One well-accepted operationalisation of these dyadic processes in social psychology research is behavioural coordination. Behavioural coordination is characterised by the spatial and/or temporal matching in the rhythms or patterns of behaviours across individuals in an interaction (eg, patients and providers), such as synchrony, leader-and-follower dynamics and turn-taking.[34–36] Coordination might manifest at the verbal (eg, word use, the contents of speech),[34 37] paraverbal (eg, pitch, tone, speed of speech),[37 38] or non-verbal levels (eg, posture, body movements, gaze)[39 40] and could be cross-modal (eg, verbal-paraverbal coordination).[34 36 37 41] Critically, coordination in dyads is thought to reflect meaningful social and cognitive connections between individuals. For example, behavioural coordination facilitates empathy and shared understanding—indicators of more constructive communication.[42–44] However, dissimilarity or social distance between dyadic partners disrupts coordination.

In the context of patient-provider communication, patients in racially concordant medical interactions (ie,

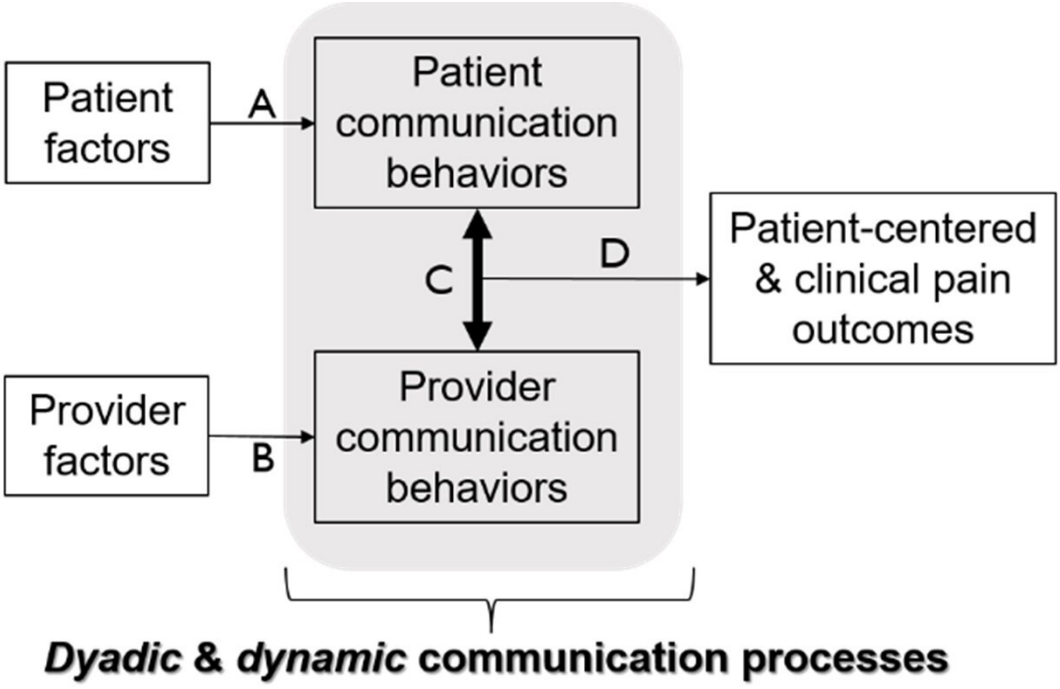

Figure 1 Our new conceptual model that highlights the central role of dyadic and dynamic communication processes in racial pain care.

when a patient and provider share the same racial background) tend to report greater perceived similarity and shared understanding with their providers, regardless of patient race, compared with those in racially discordant interactions (ie, when a patient and provider have different racial backgrounds).[45–49] Thus, we predict that racially discordant medical interactions are associated with less behavioural coordination than racially concordant ones at all behavioural levels.[50] Recent work supports this prediction in simulated medical interactions, where researchers experimentally created concordant versus discordant dyads by assigning participants to either a 'yellow group' or a 'green group'. To make group membership personally meaningful, participants were told that their group assignment was based on their core beliefs and values. Researchers found that movement synchrony (one aspect of non-verbal coordination) between individuals playing the roles of 'patient' and 'provider' was higher in ideologically concordant dyads (ie, both the 'patient' and 'provider' belonged to the same colour group). Moreover, this coordination predicted reductions in pain reported by 'patients'.[51]

However, no work has yet tested how coordination varies as a function of racial concordance and how it impacts pain care and experience in real-world medical contexts. Critically, due to the scarcity of black providers, black patients are more likely to see non-black providers even when they prefer to see black providers, whereas white patients are generally able to see white providers if they prefer.[52–54] In other words, black patients are far less likely than white patients to experience racially concordant medical interactions. Therefore, we posit that behavioural coordination, in turn, serves as the primary mechanism through which patient/provider factors contribute to racial disparities in pain care and pain outcomes (Path D).

METHODS

The overarching goal of this research is to establish the dyadic and dynamic processes underlying patient-provider communication as the key mechanism through which patient and provider factors contribute to racial disparities in both patient-centred and clinical pain outcomes. We will test our hypotheses by addressing three specific aims: (Aim 1) to compare the levels, duration, patterns and context of behavioural coordination in preoperative consultations (both overall and during pain discussion specifically) between black and white patients; (Aim 2) to elucidate links between patient/provider factors and coordination in preoperative consultations; and (Aim 3) to identify specific aspects of behavioural coordination in preoperative consultations that contribute to racial disparities in post-surgical patient-centred outcomes (eg, pain management self-efficacy, quality of life) and clinical outcomes (eg, pain level, prescriptions). These aims will be achieved through an observational study with a convergent mixed methods research design. Table 1 provides an overview of the study design. The study is funded by the National Institutes of Health/National Institute of Nursing Research from 23 September 2022 through 20 June 2027 (R01NR020030).

Our conceptual model of racial pain care disparities is applicable to any medical context that requires pain care (eg, acute pain in the emergency context, chronic pain, cancer pain) given that disparities in pain treatment,[55] management[12 14] and outcomes[56–60] are mirrored in non-surgical contexts. However, the proposed research will focus on surgical pain care for theoretical and methodological reasons. Abundant evidence demonstrates that black patients experience worse surgical care and outcomes than any other patients.[59] Black patients receive comparatively

Table 1 An overview of the study designs

Aims	Data sources	Analyses	Goals
1	Recorded encounters	Quantitative analyses of behavioural coordination between patients and surgeons during preoperative consultations Qualitative analyses of patients' and surgeons' affect ('this slices' ratings) and themes of discussion topics during preoperative consultations	Compare the levels, amount, patterns of verbal, paraverbal and non-verbal coordination during preoperative consultations between black and white patients Compare the valence and context of behavioural coordination during preoperative consultations between black and white patients
2	Surgeon baseline survey Patient baseline survey Coded preoperative consultations	Quantitative analyses of associations between the patient and surgeon factors and behavioural coordination during preoperative consultations	Identify specific patient and provider factors that contribute to racial disparities in behavioural coordination
3	Surgeon baseline survey Patient baseline survey Coded preoperative consultations Patient post-recording survey Patient postoperative survey Medical chart review	Quantitative analyses of associations between behavioural coordination during preoperative consultations and post-surgical patient-centred and clinical pain outcomes	Identify specific aspects of behavioural coordination during preoperative consultations that contribute to racial disparities in patient-centred or clinical pain outcomes

less treatment for perioperative pain and/or report comparatively higher postoperative pain intensity across a wide variety of surgical procedures,[61] including mastectomy,[62] inguinal hernia repair,[63] oral surgery,[64] orthopaedics,[65–68] appendectomy[69] and lumbar spine surgery.[70] Because surgeries are common (about 48 million patients are estimated to undergo surgeries annually[71]), a large number of black patients may receive suboptimal perioperative pain treatment and experience worse postoperative pain compared with white patients. Critically, effective patient-provider communication can reduce patient pain experience,[72 73] and discussing pain care during preoperative consultations represents a key predictor of post-surgical pain care and outcomes.[74–78] Therefore, effective communication during preoperative consultations represents a primary opportunity for eliminating disparities in pain management. However, patients and providers in racially discordant medical interactions are more likely to have reduced trust and poorer communication, leading to less dyadic decision-making, which may fuel downstream post-surgical pain disparities.[79]

Participants

We will recruit at least 15 surgeons and 150 patients (approximately equal number of black and white patients for each surgeon) from a large university health system in the US South that serves diverse patient populations. A Monte Carlo Simulation with 1000 simulated data sets was conducted based on our smallest predicted effect (ie, a small to moderate effect of surgeon implicit racial prejudice on surgeon communication behaviours in Aim 2, which we expected to require the largest sample size). The power analysis (with 8 surgeon factors and 11 patient factors in a model) revealed that we can achieve adequate power (0.80) with a total of 15 surgeons and 150 patients completing the full suite of surveys.

The eligibility criteria for surgeons are that they: (1) are practicing as attending surgeons at one of the three participating surgery clinics; and (2) have preoperative consultations with patients to discuss surgeries for one of the 18 procedures listed in table 2. We focus on those 18 procedures to minimise variability in pain intensity and duration, as well as procedural workflows and scheduling predictability. Note that the list of eligible procedures is a working list; new procedures will be added as we expand our partnerships with additional surgical divisions. The list of procedures was created and is being updated by surgeon consensus about expected post-surgical pain and validated by published guidelines[80] regarding opioid prescribing as a proxy for pain outcomes. That said, we will still control for procedure type as a covariate in our analyses. The eligibility criteria for patients are: (1) self-identify as either black/African American or white American; (2) be ≥18 years old; (3) have an appointment for any of the surgical procedures listed in table 2 with one of the participating surgeons; and (4) be able to comprehend documents in English, written at a sixth-grade reading level. The participant recruitment began on 26 October 2023 and is expected to last through 31 May 2027.

Table 2 Surgical procedures included in the present study (in alphabetical order)

Procedure	
Adrenalectomy	J-pouch
Amputation	Inguinal hernia repair
Anal condyloma excision	Liver resection
Colon resection	Mastectomy
Colostomy takedown (intra-abdominal)	Nephrectomy
Cystectomy	Parathyroidectomy
Fulguration	Prostatectomy
Gastric bypass	Sleeve gastrectomy
Haemorrhoidectomy	Thyroidectomy

Procedures

Data collection

Surgeons who meet the eligibility criteria and provide written consent are asked to complete a 25 min baseline survey online before their first recorded preoperative consultation with a participating patient. The project coordinator monitors patient appointments and identifies those who meet the eligibility criteria. Not every patient who attends preoperative consultations proceeds to have operations due to many different reasons (eg, their surgeon recommends non-surgical treatment after the consultation, the patient decides not to have surgery for their own reasons or the patient is transferred to a provider who is not participating in the research). To maximise the number of patients enrolled in our study with complete data, the project coordinator consults a surgeon on the team weekly to review imaging reports and notes in the charts to determine whether their consultation is likely to result in surgery. If we are uncertain about the likelihood of surgery, we consult with the participating surgeon for further guidance. Patients asked to complete a 45 min baseline survey over the phone following the consent and Health Insurance Portability and Accountability Act authorisation and before the scheduled appointment for preoperative consultation with their participating surgeon. (If necessary, surgeons are given the opportunity to complete the baseline survey in person via a laptop. Similarly, if necessary, patients receive a link to complete the baseline survey over the internet.)

On the day of the preoperative consultation appointment, the patient and surgeon are video-recorded and audio-recorded. We use two GoPro10 cameras

attached to the wall with Velcro: one focusing on the patient, another focusing on the surgeon. We attach the two cameras to the walls of the consultation room prior to the patient entering. The surgeon and patient meet as scheduled while we control the recording from outside of the room using The Remote, a GoPro accessory. Specifically, we stop the recording while the patient undresses for the physical examination and resume it once the patient has dressed again. We manage the camera (de)activation by monitoring the live audio stream. Moreover, a digital voice recorder captures the audio of the interaction to serve as a backup in the rare event of video failure. After the consultation, the patient is escorted to the waiting room (or stays in the examination room if the space is available) to complete a 5 min post-encounter survey.

Patients complete two additional surveys after the video-recorded preoperative consultation. Approximately 7 days before their scheduled surgery, a 5 min preoperative survey is conducted over the phone. Later, approximately 2 weeks after the surgery, a 30 min postoperative survey is completed over the phone after the patient's postoperative appointment. Surgeons receive a US$50 e-gift card after completing the baseline survey. Patients receive a US$50 e-gift card for completing the first three parts (ie, completing the baseline survey, participating in a video-recorded preoperative consultation and completing the post-encounter survey), and a US$20 gift card for completing the preoperative and postoperative surveys. Figure 2 summarises the survey data collection timeline. Finally, we conduct medical chart reviews to code: (1) comorbidities at the time of preoperative consultations; and (2) clinical outcomes between the time of surgery and the postoperative survey (about a 2-week period).

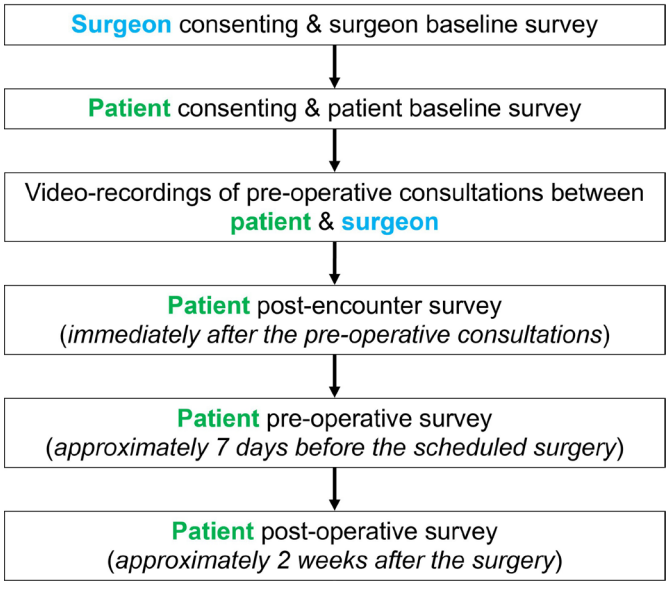

Figure 2 Overview of the study flow.

Measures

Table 4 provides an overview of the variables assessed in each survey.

Surgeon baseline survey (between consent and the first recorded preoperative consultation)

Demographic information

We assess self-reported age, ethnicity, race, gender identity and US citizenship.

Professional information

Surgeons report the year in which they received their medical degree and also when they started working at the current institution.

Prior experience with cultural competency training

Surgeons are asked to indicate if and when they last took part in cultural competency training. Providers who have participated in such training are further asked four additional questions: (1) What the main goal of the most recent training they attended was (free response box); (2) Whether the training was required (Yes/No); (3) Whether the most recent training was the first training they attended in cultural competency and related topics (Yes/No); and (4) How many hours of cultural competency-related training they have completed over the last 2 years (an approximate number). Lastly, all surgeons are asked to rate their ability to deliver culturally competent care on a scale of 1 (Poor) to 5 (Outstanding).

Prior experience with communication skills training

Similar to the assessment of prior experience with cultural competency training, surgeons are first asked to indicate if and when they last attended training in communication skills. Those who had participated in communication skills training are further asked to respond to four additional questions: (1) What the main goal of the most recent training they attended was (free response box); (2) Whether the training was required (Yes/No); (3) Whether the most recent training was the first training they attended in communication skills and related topics (Yes/No); and (4) How many hours of communication skills-related training they have completed over the last 2 years (an approximate number). All surgeons also rate their communication skills on a scale of 1 (Poor) to 5 (Outstanding).

Prior experiences with black patients

We assess surgeons' past experiences with treating black patients using two items: (1) the frequency of their interactions with black patients in their practice or training (rated on a scale from 1 (Never) to 6 (All the time)); and (2) their self-assessment of communication skills when interacting with black patients (rated on a scale from 1 (Poor) to 5 (Outstanding)).

Perceptual bias in pain recognition

Surgeons' perceptual bias in pain recognition is assessed with a computerised task designed to isolate thresholds

Table 3 An overview of the variables assessed in the surveys

	Surgeons	Patients
Baseline	► Demographic information ► Professional information ► Prior experience with cultural competency training ► Prior experience with communication skills training ► Prior experiences with black patients ► Perceptual bias in pain recognition ► Implicit racial prejudice ► Explicit racial prejudice ► Implicit racial stereotyping ► Explicit racial stereotyping ► Stereotype threat	► Demographic information ► Socioeconomic information ► Medical history ► Perceived racial discrimination ► General trust in surgeons ► General satisfaction with healthcare ► Pain sensitivity and fear of pain ► Self-efficacy for managing pain ► State pain level ► Quality of life ► Depressive symptomatology ► Anxiety
Post-encounter		► Surgeon-specific trust ► Surgeon-specific satisfaction ► Expected pain intensity and duration
Preoperative		► The number of days until surgery ► Resources given for pain and/or pain management ► Expected pain intensity and duration
Postoperative		► State pina level ► Quality of life ► Depressive symptomology ► Anxiety ► Future healthcare utilisation intentions

for seeing pain on black versus white faces. This task has been extensively used in non-clinical populations. For example, a recent meta-analysis comprising 40 studies and over 6000 participants demonstrated that racial bias in pain perception generalises across perceiver race and robustly predicts a corresponding tendency to recommend prescribing relatively less pain reliever to black (vs white) targets.[81] Moreover, across this work, the influence of this perceptual bias on hypothetical treatment recommendations persists even when accounting for explicit racial biases and stereotypes.[25 82] While this work was primarily conducted on non-clinical populations, forthcoming work in progress demonstrates that each of these findings generalises to perceivers with training or experience working in clinical contexts.

Surgeons see equal numbers of digitally rendered black and white faces making pain expressions (six morphs per target, ranging from neutral to 100% pain in 20% increments, with expression intensity and facial structure equated across race). For each morph, presented one at a time, surgeons make a continuous rating of perceived pain in response to the question 'Is this face in pain?' on a 1–7 scale (1='Definitely not in pain', 7='Definitely in pain'). Following our procedures in previous work, these ratings are used to compute points-of-subjective-equality (PSEs) representing surgeons' perceptual thresholds for recognising pain—in other words, the point in the morph continuum where someone would be equally likely to see a face as being in pain versus not in pain. Specifically, these ratings are rescored to a 0–1 scale and, using the curve-fitting function fit in MATLAB, fit to an S-shaped psychometric curve approximated by a cumulative normal distribution function. Higher PSE values represent higher pain perception thresholds. This task reliably predicts racial bias in pain treatment recommendations[25 82] over and above explicit racial bias or racial stereotypes regarding status, strength, threat or pain sensitivity.

Implicit racial prejudice

A well-validated Race Implicit Association Test (Race IAT[83]) is used to evaluate surgeons' implicit racial prejudice. Surgeons categorise photographs and words that appear on the computer screen into four groups: two racial groups (white vs black) and two evaluations (good vs bad), which are presented in pairs. The premise is that individuals respond more quickly when the racial category and evaluation mapped onto the same response are strongly associated compared with when they are weakly associated. In the Race IAT, photographs of faces represent the two racial groups, while 16 words (8 positive: marvellous, superb, pleasure, beautiful, joyful, glorious, lovely, wonderful; and 8 negative: tragic, horrible, agony, painful, terrible, awful, humiliate, nasty) represent the

evaluative categories. We used the standard algorithm to compute a D score, which ranges from −2.0 to 2.0, to measure implicit associations (average inter-item consistency α=0.78[84]); this approach has been well validated.[85–88] Higher scores indicate greater pro-white and anti-black preference.

Explicit racial prejudice

Surgeons' explicit racial prejudice is assessed with two measures: the feeling thermometer and Symbolic Racism Scale 2000 (SR2K). The feeling thermometer is a single scale measure in which surgeons rate their feelings toward each racial social group on a scale from 0 (very cold/unfavourable) to 100 (very warm/favourable[89 90]). Similar to D scores in the IAT, composite explicit pro-white/anti-black prejudice scores are calculated by subtracting the score for black Americans from a score for white Americans. Positive values indicate explicit preference for white Americans over black Americans, whereas negative values indicate explicit preference for black Americans over white Americans. A value of zero indicates no explicit preference between black and white Americans. The SR2K is the most up-to-date scale of symbolic racism that is designed to measure people's belief system based on the ideas that racial discrimination is no longer an issue in the USA and that black Americans' demands for fairness are unjustified.[91–93] The SR2K has been found to be reliable (ie, an average α around 0.75) and well-validated in more than two dozen empirical studies.[94]

Implicit racial stereotyping

Implicit racial stereotyping is assessed using the medical cooperativeness IAT, an implicit measure of racial stereotyping commonly used in research on racial health disparities.[95–97] This task mirrors the Race IAT but replaces the two evaluative categories (good vs bad) with two stereotyping categories (medically cooperative vs medically uncooperative). Specifically, the 16 words categorised into evaluations (good vs bad) in the Race IAT are substituted with 12 words categorised into stereotypes (6 words associated with cooperativeness: willing, cooperative, compliant, reliable, adherent, helpful; and 6 words associated with uncooperativeness: reluctant, doubting, hesitant, apathetic, resistant and lax). D scores are calculated using the same methodology as for the Race IAT. Higher positive values indicate strong implicit associations of white (vs black) Americans with medical cooperativeness, whereas higher negative values indicate stronger implicit associations of black (vs white) Americans with medical cooperativeness.

Explicit racial stereotyping

Surgeons respond to two measures of stereotypes: a 32-item assessment aimed at evaluating general racial stereotypes (16 items for black Americans and 16 items for white Americans, such as unintelligent, lazy, low socioeconomic status),[98] and a 22-item evaluation designed to gauge stereotypes specifically within the medical context (11 items for black Americans and 11 items for white Americans, such as medical cooperativeness, health literacy, motivation).[98] These measures were adapted from previous studies of racial stereotyping.[28 99] Surgeons are instructed to review statements and indicate the degree to which each statement describes characteristics of black versus white Americans using a Likert scale ranging from 1 (very untrue) to 6 (very true). Consistent with the procedure used in prior research, composite scores are calculated for general and medicine-specific stereotypes separately. More specifically, first, negatively worded items will be reverse-coded, and the average score for each racial category will be computed. Subsequently, the average score for black Americans will be subtracted from the average score for white Americans. Higher positive values indicate a stronger explicit association of white Americans (vs black Americans) with more positive stereotypes, while higher negative values indicate a stronger explicit association of black Americans (vs white Americans) with more positive stereotypes.

Stereotype threat

We assess the degree to which surgeons are concerned about being perceived as prejudiced by black patients by using a modified version of the Explicit Stereotype Threat Scale.[100] The measure consists of four items (eg, 'I worry that my black patients might stereotype me as racist because of my race'), and the scale ranges from 1 (Strongly disagree) to 4 (Strongly agree). Higher scores indicate higher levels of stereotype threat.

Patient baseline survey (between consent and recorded preoperative consultation)

Demographic information

We assess self-reported age, race, ethnicity, gender identity, pronouns they use, sexual orientation, US citizenship, height and weight (to compute body mass index), physical activity, marital status, education, income and health insurance.

Medical history

Patients also indicate if, for what and how many surgeries they have had previously. Patients also report if they have ever been prescribed opioids for severe pain and whether it was helpful.

Perceived racial discrimination

Patients are asked to complete two well-validated measures of perceived racial discrimination that have been used in health research and social psychology research previously. The first is the Brief Perceived Ethnic Discrimination Questionnaire-Community Version (α=0.87) that assesses both daily and lifetime experience of multiple forms of discrimination (eg, exclusion, stigmatisation, threat) in multiple domains (eg, work, public places).[101] Participants will be asked to use a scale ranging from 1 (Never) to 5 (Very often). The second measure assesses the perceptions of racial discrimination at both personal and group level.[102 103]

More specifically, five items are designed to assess the degree to which patients have experienced discrimination personally (α=0.84), and three items are designed to assess the degree to which patients perceive other members of their racial group in general experience racial discrimination (α=0.84). Both subscales are assessed by using response items that range from 1 (Strongly disagree) to 5 (Strongly agree).

General trust in surgeons

We assess patients' expectations about their trust in surgeons in general at the participating health system with a modified version of the Wake Forest Physician Trust Scale, which has been found to have better internal consistency (α=0.93, test–retest reliability=0.75), validity, discriminability and scale distribution as compared with other trust scales.[104 105] To account for patients having never met with a surgeon, they are instructed to indicate how they expect to feel regarding trust in their surgeons. The response items range from 1 (Strongly disagree) to 5 (Strongly agree).

General satisfaction with care

We use a modified version of the Patient Satisfaction Questionnaire Form III[106] (PSQ-III) to assess patients' satisfaction with the specific healthcare system in general, as opposed to satisfaction with surgeons within the specific healthcare system, because the vast majority of patients have had no prior experience with surgeons. In particular, we use three subscales: general satisfaction (α=0.88), interpersonal aspects (α=0.82) and communication (α=0.82). The response items range from 1 (Strongly disagree) to 5 (Strongly agree).

Pain sensitivity and fear of pain

We assess pain sensitivity and fear of pain because they are predictive of post-surgical pain outcomes.[107–117] Pain sensitivity is assessed with the Pain Sensitivity Questionnaire (PSQ). The PSQ correlates with pain induced experimentally in healthy participants[118 119] and chronic pain patients.[120 121] Fear of pain is assessed with the short form of the Pain Anxiety Symptoms Scale,[122] which has shown strong internal consistency, reliability and good predictive and construct validity.[123–126]

Self-efficacy for managing pain

Self-efficacy for managing pain is defined as the confidence individuals have in engaging in activities while in pain. It has been shown to predict not only experiences of and reactions to pain but also overall clinical outcomes.[127–132] Pain self-efficacy is assessed with the well-validated Pain Self-Efficacy Questionnaire,[133] which has been used in multiple clinical settings.[134–137]

State pain level

We assess state pain level with the Numerical Rating Scale (NRS-11), the most widely used, well-validated[138–141] scale in the clinical setting. The scale ranges from 0 (no pain) to 10 (very severe).

Quality of life

Quality of life is assessed with the 36-item Short Form (SF-36) Health Survey,[142] which has been validated in diverse populations,[143] including pain patients.[144–146] We use the SF-36 Health Survey (rather than pain-specific quality of life) because patients in our sample have a variety of medical conditions although they all require surgeries.

Depressive symptomatology

We use the Personal Health Questionnaire Depression Scale (PHQ-8),[147] as opposed to the more widely used PHQ-9,[148 149] to avoid directly asking patients to report their suicidal thoughts (ie, the last item in the PHQ-9). This 8-item scale is designed to capture both overall depression severity and specific symptoms, has been well-validated,[150] is strongly correlated with the PHQ-9 (r=0.99) and can be self-administered.

Anxiety

Anxiety is assessed using the State-Trait Anxiety Inventory,[151] a 40-item scale measuring acute and chronic anxiety symptoms. The scale has been used extensively, including in black Americans.[152 153]

Patient post-encounter survey (immediately after recorded preoperative consultation)

Surgeon-specific trust

We assess patient trust in the specific surgeon they have just met with a modified version of the Wake Forest Physician Trust Scale.[104] Items are modified to reflect the specific surgeon a patient saw during their preoperative consultation.

Surgeon-specific satisfaction

Patient satisfaction with the specific surgeon they have just met with is assessed with a modified version of the PSQ-III.[106] Again, items are modified to reflect the specific surgeon a patient saw during their preoperative consultation.

Expected pain intensity and duration

Patients report their expected post-surgical pain, once again using the NRS-11,[138–141] ranging from 0 (no pain) to 10 (worst possible pain). Specifically, patients report these expectations for five separate points in time—immediately after their procedure, 1 week after their procedure, 2 weeks after their procedure, 1 month after their procedure and 3 months after their procedure. For each time point, patients are given the opportunity to select a 'Not sure' option.

Patient preoperative survey (approximately 7 days before surgery)

First, patients report the number of days until their surgery. Next, patients are asked about the resources they have been directed to regarding pain and/or pain management. Patients answer separate questions regarding resources (1) their surgeon recommended, (2) other medical professionals recommended, (3) family, friends or coworkers recommended or (4) that

they themselves sought out. In each case, patients first give a 'Yes', 'No' or 'I'm not sure' response. In instances where patients supply a 'Yes' response, a free response box appears, asking them to describe the resources they were directed to or sought out.

Patients then complete the same adapted NRS-11[138–141] measure of their expected post-surgical pain using the same approach (and at the same time points) as in the patient baseline survey.

Patient postoperative survey (approximately 2 weeks after surgery)

State pain level, quality of life, depressive symptomology, state and trait anxiety and future healthcare service utilisation intentions are once again assessed using the same methods as in the patient baseline survey. For each of these measures, we compute a difference score (via subtraction) representing the change in each outcome from baseline to postoperative follow-up.

Medical chart reviews

We conduct medical chart reviews and code comorbidities at the time of preoperative consultations. Comorbidities will be used to control for potential systematic variability in both post-surgical patient-centred and clinical outcomes. We will also code clinical outcomes between the time of surgery and the postoperative survey (about a 2-week period). Specifically, we will code (1) type of anaesthetic used in procedure[154]; (2) pain prescriptions (ie, type, dosage and duration); (3) the number of healthcare visits for post-surgical pain management (greater visits indicating poorer pain management); (4) documented pain score (if any)[155]; (5) surgical complications; and (6) pain-related comorbidities that are independent of pain directly related to the surgical procedure. Finally, surgeons on the research team will independently code the appropriateness of anaesthetic/pain prescriptions (−3 (pain is grossly undertreated) to +3 (pain is grossly overtreated), with 0 being the right pain treatment) for a given surgical procedure using the published guidelines[80] while taking into account comorbidities. They will be kept blind to patient race or surgeons. Their scores will be averaged to compute a composite score.

Analysis

Analysis of recorded preoperative consultations

We are going to use recorded preoperative consultations to assess the levels, duration, patterns and context of behavioural coordination. Specifically, we will (1) obtain numerical quantifications of verbal, paraverbal and non-verbal coordination between patients and surgeons (eg, the level and duration of coordination, the frequency of disruptions to coordination, patterns of coordination); (2) qualitatively describe the valence and context of quantified verbal, non-verbal and paraverbal coordination; (3) test whether the level of behavioural coordination during preoperative consultations is higher for white (vs black) patients; and (4) identify which aspects of behavioural coordination differ between black and white patients and understand why these differences occur.

Quantitative analysis of behavioural coordination

We will assess coordination between patients and surgeons in preoperative consultations, both overall and during pain discussion specifically, using cross recurrence quantification analysis (CRQA). CRQA is a cutting-edge, fully automated statistical analysis that enables us to quantify the level and duration of behavioural coordination at verbal, paraverbal and non-verbal levels during dyadic social interactions. It also provides information about who initiates changes in the levels of coordination and whether these changes are followed by the other member of the dyad (ie, identification of a leader and a follower). CRQA takes two (ie, patient and provider) numbers (or 'signals') in chronological order as input and outputs quantifications of the coordination dynamics of the dyad (recurrence rate, % determinism, diagonal length, entropy, laminarity, trapping-time). CRQA analyses a recurrence plot—a graph that crosses the two signals by putting one on the x-axis and the other on the y-axis and plots a recurrence point when the two signals have overlapping values[156] (see figure 3 for examples). All CRQA metrics are derived from calculations on this graph.[157]

We will quantify the coordination dynamics that characterise patient–surgeon interactions in terms of verbal (eg, using unique number-word assignments as input), paraverbal (eg, extracting waveform and specific frequencies/amplitudes from audio signal) and non-verbal behaviours (eg, overall body movement magnitude derived from changes in pixel colour and intensity).[158 159] Specifically, we will include recurrence rate (coordination over time), per cent determinism (magnitude of coordination over time), diagonal lengths (time-location and length of coordination), entropy (a measure of the unpredictability of the interaction), laminarity (stability of coordination) and trapping time (independence). Technically, we will use the statistical computing environment R/RStudio[159] to calculate CRQA measures for patient–surgeon dyads across each communication modality. Using the R package 'crqa',[160] the coordination dynamics for each dyad will be modelled to optimise hyperparameters (ie, embedding dimension, delay and radius) by finding the lag at which minimal mutual information is observed, fixing the relative information percentage gain in the false nearest neighbours test to 5% relative to the first embedding dimension, and testing a range of radius values that result in such recurrence rates 2% and 10% (0.02 >Reccurence Rate % > 0.10). CRQA calculations have been described in detail elsewhere[159–161] and these summary metrics will be used to operationalise communication dynamics across all three modalities.[162–164] These values can be used as dependent or independent variables depending on the question (eg, does the patient or surgeon lead the interaction (recurrence rate); are racially concordant interactions more/less coordinated (% determinism) or unpredictable (entropy); at what

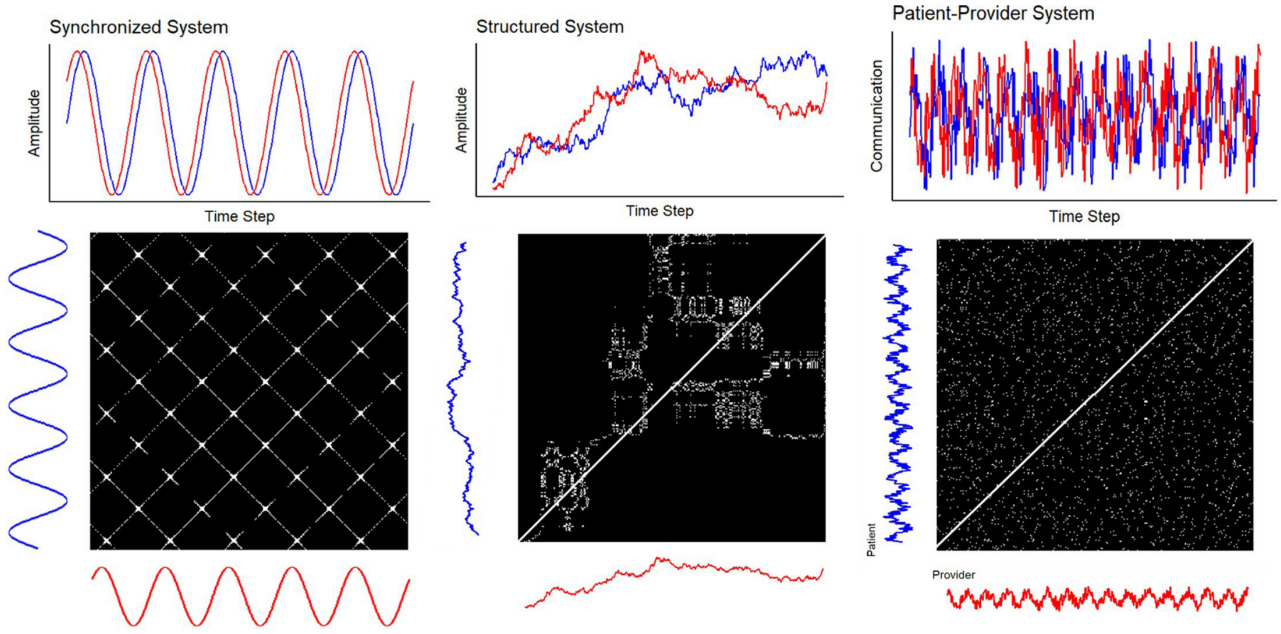

Figure 3 Example recurrence plots that depict different system types.

time points are communication most synchronised (diagonal lengths)?).

Qualitative analysis of the valence of behavioural coordination

We will use the 'thin slices' methodology to obtain ratings of patients' and surgeons' positive and negative affect. Research on person perception has shown that people can quickly and accurately judge affect with thin slices (between 2 s and 5 min) of non-verbal behaviours.[165–167] Our work has also shown that ratings of physician affect obtained from naive observers using 'thin slices' are associated with physicians' implicit and explicit prejudice.[20] Critically, other work has shown the utility of the thin slices methodology in capturing patient emotion specifically during pain discussions.[168 169] We will create 'thin slices' in two ways (there can be overlaps between the two). First, we will edit the video recordings to create the pain versus general (eg, non-pain) discussion sections. For each, we will create a 2 min excerpt, which will begin the moment either a patient or a surgeon initiates a discussion about pain or a topic unrelated to pain (eg, explanation of a surgical procedure; but excluding greeting at the beginning) and will end after 2 min elapse, regardless of whether the discussion on the topic is still going. Second, we will create two 2 min excerpts for each point of disruption to behavioural coordination identified by the CRQA: one capturing patient–surgeon communication up to the disruption, another capturing communication immediately after the disruption.

Each excerpt will be rated by 20 racially diverse research assistants (RAs). Overthinking and reasoning can often disrupt judgement accuracy, and people usually make better judgements when they do not try to explain their judgements.[164 165] Thus, we will instruct RAs to report their first impressions. RAs will view excerpts one by one and provide their judgements of: (1) patient affect (eg, positive: cheerful, friendly, warm; negative: cold, nervous, stressed); and (2) surgeon affect.[20] The order of these categories and of excerpts within each category will be randomised across RAs. Ratings will be averaged across RAs because aggregated judgements better predict outcomes than judgements made by single observers.[165]

Qualitative analysis of the context of behavioural coordination

The recorded preoperative consultations will be transcribed verbatim to identify discussion themes in five steps. Step 1 involves unitisation of thought units. Unitisation is a step in qualitative research where researchers break down a large amount of qualitative information (eg, transcripts, written responses or observations) into smaller pieces called units that make sense on their own (eg, utterances, paragraphs, discrete thoughts).[170–172] In the current project, we will use discrete thoughts as units. Two RAs will be trained to unitise a few transcripts until they achieve consensus. After the training, the RAs will unitise the remaining transcripts. They will meet with one of the senior research team members after unitising every 10 transcripts to discuss discrepancies and achieve consensus. Step 2 involves categorisation of thought units into three groups: (1) thought units related to pain; (2) thought units not related to pain; and (3) thought units that are being discussed at the moment of the disruptions to behavioural coordination identified by the CRQA. Thought units categorised into the third group are not mutually exclusive from those categorised in the other two categories. Step 3 involves the development of a codebook for each group of thought units. Several senior research team members will review approximately 50% of the thought units within each group inductively to identify a comprehensive list of themes (eg, emotional expressions, affirmation of concerns, questions about post-surgical pain and explanation of pain management

Table 4 Integration of qualitative and quantitative data

Qualitative questions	Behavioural coordination quantified by the CRQA
1. What are the average patient affect, the average surgeon affect and the main discussion themes a. During discussions unrelated to pain in patient–surgeon dyads b. During pain discussions in patient–surgeon dyads	► With higher (+1 SD) vs lower (−1SD) levels of coordination overall as well as during pain discussions specifically? ► With longer (+1 SD) vs shorter (−1SD) duration of coordination overall as well as during pain discussions specifically? ► Within each type of coordination (eg, synchrony, turn-taking, leader-follower) overall as well as during pain discussions specifically? ► With different sequential patterns of coordination (ie, increasing, decreasing, stable, fluctuating) overall as well as during pain discussions specifically?
2. What affect a patient and a surgeon each were displaying and what were they discussing:	► Immediately before vs after disruptions to coordination?

CRQA, cross recurrence quantification analysis.

plans). Identified themes will then be refined, collapsed and organised into categories. For example, 'emotion expressions' and 'affirmation of concerns' may be organised under a higher order theme of 'discussions of emotions', and 'emotion expressions' may be further refined and divided into 'positive emotion (eg, relief, excitement)' and 'negative emotions (eg, fear, anxiety)'. The codebooks will provide coding procedures, rules for coding, descriptions and examples of the codes. Step 4 involves the coding of the remaining thought units. Two RAs will be trained on the three codebooks using~10% of these thought units (or until they reach consensus) within each group. The codebooks will be fine-tuned during this period. After the training, the RAs will code the remaining thought units while meeting with a senior research team member each time after they code an additional 10% of thought units to discuss discrepancies and reach consensus. We will use NVivo to categorise, sort and link data across transcripts. We will assess the frequency of each theme within each preoperative consultation. Step 5 involves integration of qualitative and quantitative data (table 4). We will use qualitative results to characterise: (1) quantitative variation in the levels (eg, higher vs lower), duration (eg, longer vs shorter), type (ie, synchrony, turn-taking, leader-follower) and sequential patterns (ie, increasing, decreasing, stable, fluctuating) of behavioural coordination across patient–surgeon dyads; and (2) the occurrences of disruptions to behavioural coordination.

Aim 1: to compare the levels, duration, patterns and context of behavioural coordination in preoperative consultations between black and white patients

To test our hypothesis that behavioural coordination during preoperative consultations is higher for white patients than for black patients, we will conduct a regression using a Generalised Estimating Equations (GEE) framework. GEE treats surgeons as a nuisance parameter and corrects biased estimates due to non-independence of a surgeon seeing multiple patients. This analytical approach is common in the existing patient-provider communication literature[173–177] and was used successfully in our prior work.[178 179] The regression will include patient factors (assessed in the patient baseline survey, such as education) and surgeon factors (assessed with the surgeon baseline survey, such as cultural competency training), and clinical factors (eg, procedure type; as well as those obtained through medical chart reviews, such as comorbidities) that are significantly correlated with coordination level as covariates. We will also test if the results are moderated by patient–surgeon racial concordance/discordance. Approximately 80% of the eligible surgeons are white; thus, the majority of black patients are likely to engage in racially discordant consultations, whereas the majority of white patients are likely to engage in racially concordant consultations. However, because the study will be open to surgeons of all racial and ethnic identities, we will explicitly examine the role of racial concordance as a potential moderator. If the statistical power is too weak to detect the expected moderating effect of patient-provider racial concordance/discordance due to a small number of surgeons who identify as black/African American, we will treat patient-provider racial concordance/discordance as a covariate in our analyses instead. Additionally, we will conduct a descriptive examination of data based on patient–surgeon racial concordance/discordance to identify patterns and trends, which will inform research questions and hypotheses for future studies.

To further identify which additional specific aspects of behavioural coordination differ between black and white patients, we will conduct the same set of regressions with GEE (with patient race as a predictor, patient and surgeon factors as covariates and racial concordance as a moderator) for each aspect of quantified behavioural coordination. We will correct the family-wise error rate due to multiple testing with the Bonferroni correction procedure.[180 181] Finally,

we will explore why aspects of behavioural coordination identified by the previous analyses differ across patient race and patient–surgeon racial concordance by reviewing the integrated data (table 3) and exploring the patterns of valence and themes which characterise coordination in dyads with black versus white patients.

Aim 2: to elucidate links between patient/provider factors and coordination in preoperative consultations

We will assess relationships between patient factors recorded in the patient baseline survey and specific aspects of behavioural coordination (eg, levels, duration, patterns) assessed in Aims 1. Patient factors can be distilled into race-related factors and health-related factors (online supplemental table 1). In Step 1, we use confirmatory factor analysis (CFA) to examine the latent structure of the patient-level variables and determine whether any patient factors can be aggregated in subsequent analyses. In Step 2, we identify covariates that may impact behavioural coordination by computing correlations among all variables assessed in the patient baseline survey and medical chart review. In Step 3, we compute partial correlations between each patient factor and each measure of behavioural coordination, while controlling for covariates identified in Step 2. In Step 4, we will conduct regressions with GEE using the patient factors remaining significant in Step 3, with the same set of covariates included. This approach enables us to examine which patient factors are most strongly associated with coordination. Again, we will correct the family-wise error rate due to conducting multiple regression tests with the Bonferroni correction procedure. Finally, in Step 5, we will explore whether the associations between patient factors and specific aspects of behavioural coordination identified in Step 4 vary by patient race (black vs white) or patient–surgeon racial concordance.

We will also examine relationships between provider factors recorded in the surgeon baseline survey and specific aspects of behavioural coordination (eg, levels, duration, patterns) assessed in Aim 1. Provider factors can be collapsed into health-specific and general racial bias factors. We will first use CFA to determine if any provider factors can be aggregated in subsequent analyses (Step 1). We then identify covariates that may impact coordination by computing correlations among all variables assessed in the surgeon baseline survey (Step 2). After assessing partial correlations (controlling for covariates identified in Step 2) between each provider factor and each measure of behavioural coordination (Step 3), we will use GEE to examine which provider factors are most strongly associated with behavioural coordination while controlling for the same set of covariates (Step 4). Finally, we will explore whether these relationships vary by patient race (black vs white) or patient–surgeon racial concordance (Step 5).

Aim 3: to identify specific aspects of behavioural coordination in preoperative consultations that contribute to racial disparities in post-surgical patient-centred and clinical outcomes

In Step 1, we identify outcomes of interest demonstrating racial disparities. We will conduct regressions with GEE to assess whether any of the outcomes listed in online supplemental table 2 vary between black and white patients. In Step 2, we identify covariates. We will conduct correlations to assess whether any potentially confounding factors assessed at baseline (eg, demographic factors, individual differences in pain sensitivity and pain anxiety) covary with change from baseline to the preoperative consultations or 2-week post-surgery follow-up in terms of the patient-centred or clinical outcomes identified in Step 1. In Step 3, we calculate partial correlations assessing the extent to which behavioural coordination correlated with racial disparities in the outcomes (identified in Step 1), while controlling for covariates identified in Step 2. Finally, in Step 4, we conduct a series of regressions using GEE for each outcome that remains significant in Step 3. We will include the same covariates as in Step 3 and correct for multiple comparisons using the Bonferroni procedure.

Patient and public involvement

Patients or the public are not involved in the design, or conduct, or reporting, or dissemination plans of our research.

ETHICS AND DISSEMINATION

The study is conducted in accordance with the Declaration of Helsinki, and ethical approval has been obtained from the Virginia Commonwealth University (VCU) Institutional Review Board (HM20023574). Both surgeons and patients are encouraged to ask questions during the consenting process and before they sign the consent form. It is made clear to the surgeons and patients that they have the right to withdraw from the study at any time even after they have signed the consent form. This study involves no more than minimal risk. However, in the event of a serious adverse event, we will report this to the VCU Institutional Review Board within 48 hours. Findings will be disseminated through presentations at scientific conferences, publications in peer-reviewed journals and speaking engagements with clinician stakeholders. We will also share the main findings from this project with patients via a newsletter on completion of the entire project.

DISCUSSION

This proposed research seeks to shift current research paradigms in racial pain care disparities by both taking a novel theoretical and methodological approach. Our theoretical innovations are reflected in our conceptual model,[31] which places unprecedented importance on dyadic and dynamic communication processes (eg, behavioural coordination) as the key mechanism through which patient/provider factors contribute to racial disparities in pain care and outcomes. Studying the entire chronology of racial pain care disparities—from patients' and providers' attitudes and perceptions, through dyadic interaction, and finally, to outcomes—in natural clinical settings also enables us to identify novel, ecologically valid intervention points. In turn, it is our hope that interventions informed by this approach will be more feasible, scalable and effective, compared with interventions based on laboratory-based experimental work alone.

Identifying and addressing patient and provider factors that fuel racial pain care disparities is an important and ideal goal. However, this goal is unlikely to be effective on its own—or even attainable in the first place. This is because patient and provider factors (eg, patient mistrust, provider bias) reflect individuals' perceptions, attitudes and reactions that exist within and are shaped by broader societal systems that are carefully designed to maintain the status quo that marginalises racial and ethnic minorities.[182–184] Thus, rather than reducing patient mistrust or provider bias, a viable alternative approach is to train providers to better manage their communication with patients. What makes our approach unique and different from the existing training and interventions focusing on patient-provider communication is, again, our emphasis on behavioural coordination. Current patient-provider communication training programmes are designed to improve providers' communication behaviours in isolation and fail to consider patients' contributions to these dyadic interactions.[185–191] To reduce racial pain care disparities effectively, it is essential to identify exactly what triggers disruptions in coordination, at which behavioural level, by whom and in what sequence. Above all, it is critical to answer these questions within a naturalistic context. Once we identify specific aspects of behavioural coordination associated with racial disparities in pain care and outcomes, we can design interventions to help providers learn how to detect potential triggers of disruptions in coordination during their communication with patients and proactively avoid disruptions in coordination. Such interventions can also help providers learn how to increase or restore behavioural coordination with patients with diverse communication styles and practice those strategies. In sum, this work will triangulate on factors that provide the biggest return on investment for future interventions.

Limitations

First, one might anticipate that surgeons may try to modify how they interact with patients when being recorded. However, our goal is to assess the strength of the associations between patient/provider factors and behavioural coordination, not the absolute levels of behavioural coordination. Therefore, as long as there is variability in providers' communication behaviours, this goal is still feasible. Indeed, in previous work using similar video recording procedures, we were able to capture variability in physicians' communication behaviours, which were systematically associated with implicit racial prejudice.[20 178 179 192–194] There is no theoretical basis to expect that surgeons would differ in social desirability concerns from the physicians in our prior work. Our previous findings are also consistent with a large body of literature showing that bias in medical contexts manifests via automatic rather than deliberative processes.[95] Consequently, surgeons may be able to modify their verbal behaviours, but they are likely to have difficulty regulating their nonverbal and paraverbal behaviours.

Second, the proposed research focuses only on the planned surgical settings. From a methodological standpoint, focusing on preoperative consultations minimises inherent variability across care contexts (eg, surgical vs non-surgical care, acute vs chronic pain care, planned vs emergency care) and provides greater precision in testing our conceptual model. However, findings from the present study may be generalisable to patient–surgeon dyads in acute pain management in emergency settings, as well as a variety of patient-provider dyads (eg, primary care providers, specialists, integrative medicine providers, pain specialists, physical therapists) in chronic pain management settings. That said, these other contexts may be subject to the influence of other factors that are not present in the current work. After validating our conceptual model in the context of preoperative consultations, our future work will systematically examine whether this model is generalisable to other clinical contexts involving pain. Such empirical evaluation of the model's generalisability will further contribute to theory development. Relatedly, once we test and refine our conceptual model, we will assess its generalisability beyond the current institutional and geographical contexts.

Lastly, despite strong evidence of gender-based pain disparities, we are unable to examine the potential intersectional effects of race and gender in pain disparities due to the small surgeon sample size. Because the proposed study focuses on racial pain disparities, we will treat gender as a covariate rather than a second moderator in our hypothesis testing. This analytical approach aligns with prior research on racial pain disparities.[12 14 16]

Author affiliations
[1]Department of Public Health Sciences, University of Virginia, Charlottesville, Virginia, USA
[2]Department of Surgery, Virginia Commonwealth University, Richmond, Virginia, USA
[3]Department of Psychology, Davidson College, Davidson, North Carolina, USA
[4]Virginia Commonwealth University, Richmond, Virginia, USA
[5]Department of Pediatrics, Virginia Commonwealth University, Richmond, Virginia, USA

[6]Department of Psychology, Virginia Commonwealth University, Richmond, Virginia, USA
[7]Department of Psychology, University of Delaware, Newark, Delaware, USA

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ORCID iD
Nao Hagiwara http://orcid.org/0000-0003-3933-8917

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