Interprofessional Discussion for Knowledge Transfer in a Digital 'Community of Practice' for Managing Pneumoconiosis: A Mixed Methods Study

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Abstract

Background: Pneumoconiosis prevalence is increasing in rural US, especially among coal miners. Contemporaneously with an increased need for miners for specialized multidisciplinary care, there is a shortage of experts to fulfill this need. Miners' Wellness ECHO is a digital community of practice based on interprofessional discussion for knowledge transfer. The program has been demonstrated to increase participants' self-efficacy for clinical, medicolegal, and “soft “skills related to miners' health.

Objective: To examine characteristics associated with interprofessional discussions and suggest ways to strengthen knowledge transfer.

Methods: This mixed methods study used an exploratory sequential design. We video-recorded and transcribed ECHO sessions over 14 months from July 2018 to September 2019 and conducted content analysis to examine discussions among participants. We focused on participants’ statements of expertise followed by other participants' acceptance or eschewal of these statements (together described as utterances). We then conducted quantitative analyses to examine the association of active participation in discussion (primary outcome variable, defined as making any utterances). We analyzed the association of the outcome on the following predictors: 1) participant group status, 2) study timeframe, 3) participant ECHO experience status, 4) concordance of participant group identity between presenter and participant, 5) video usage, and 6) attendance frequency. We used generalized estimating equations approach for longitudinal data, logit link function for binary outcomes, and LSmeans to examine least squares means of fixed effects.

Results: We studied 23 sessions, with 158 unique participants and 539 total participants, averaging 23.4 (SD=5.6) participants per session. Clinical providers, the largest participant group constituting 37% (n=58) of unique participants, were the most vocal group (21.74 [SD=2.11] average utterances per person-session). Benefits counselors were the least vocal group, with average utterance rate of 0.57 (SD=0.29) per person-session and constituting 8% (n=13) of unique participants. Thus, various participant groups exhibited different rates of utterances across sessions (p=0.003). Experienced participants may tend to dominate active participation in discussion compared to those with less or intermediate experience levels, but this difference was not statistically significant (p=0.11). When the didactic presenter and participant were from the same participant group, active participation by the silent group participants was greater than when both were from different groups. This association was not seen in vocal group participants (interaction p=0.003). Compared to those participating by audio, those participating on video tended to have higher rates of active participation, but this difference was not statistically significant (p=0.11).

Conclusions: Our findings provide insight into the mechanics of interprofessional discussion in a digital community of practice managing pneumoconiosis. Our results underscore the capacity of the novel ECHO model to leverage technology and workforce diversity to facilitate interprofessional discussions on the multidisciplinary care of miners. Future research will evaluate whether this translates into improved patient outcomes. Clinical Trial: N/a

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ABSTRACT (Word count: 450 words)

Background: Pneumoconiosis prevalence is increasing in rural US, especially among coal miners. Contemporaneously with an increased need for miners for specialized multidisciplinary care, there is a shortage of experts to fulfill this need. Miners' Wellness ECHO is a digital community of practice based on interprofessional discussion for knowledge transfer. The program has been demonstrated to increase participants' self-efficacy for clinical, medicolegal, and “soft “skills related to miners' health.

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Results: We studied 23 sessions, with 158 unique participants and 539 total participants, averaging 23.4 (*SD*=5.6) participants per session. Clinical providers, the largest participant group constituting 37% (n=58) of unique participants, were the most vocal group (21.74 [*SD*=2.11] average utterances per person-session). Benefits counselors were the least vocal group, with average utterance rate of 0.57 (*SD*=0.29) per person-session and constituting 8% (n=13) of unique participants. Thus, various participant groups exhibited different rates of utterances across sessions (p=0.003). Experienced participants may tend to dominate active participation in discussion compared to those with less or intermediate experience levels, but this difference was not statistically significant (p=0.11). When the didactic presenter and participant were from the same participant group, active participation by the silent group participants was greater than when both were from different groups. This association was not seen in vocal group participants (interaction p=0.003). Compared to those participating by audio, those participating on video tended to have higher rates of active participation, but this difference was not statistically significant (p=0.11).

Conclusions: Our findings provide insight into the mechanics of interprofessional discussion in a digital community of practice managing pneumoconiosis. Our results underscore the capacity of the novel ECHO model to leverage technology and workforce diversity to facilitate interprofessional discussions on the multidisciplinary care of miners. Future research will evaluate whether this translates into improved patient outcomes.

KEYWORDS
digital community of practice; knowledge transfer; pneumoconiosis; telementoring; rural health care; rural professionals; multidisciplinary management; interprofessional discussion; miner health; health equity;

INTRODUCTION

Mining dust-related diseases (eg, pneumoconiosis) are increasing in rural US, especially among coal miners [1-4]. The 2017 prevalence of radiographic pneumoconiosis for coal miners with over 25 years of underground mining experience was greater than 10%, double the prevalence from the late 1990s [1]. Similarly, the 2014 rate of complicated pneumoconiosis (a particularly deadly form) among long-tenured underground coal miners was 1.1%, compared to 0.3% at its lowest point in the late 1990s [5].

Miners are medically vulnerable, underserved, and often underinsured. Many miners live in rural, remote, and mountainous locations in the Mountain West and Appalachia, constituting the "hot spot" regions of pneumoconiosis prevalence and mortality [6]. The prevalence of radiographic and complicated pneumoconiosis is the highest among all US miners in rural central Appalachia [7, 8].

The re-emergence of pneumoconiosis presents unique challenges for rural communities. Compared with urban residents, those in rural areas have less access to outpatient pulmonary rehabilitation [9], primary care physicians [10], and pulmonologists [11]. Rural practitioners also face unique challenges, including professional isolation and complex patient profiles [12], and describe multiple barriers to knowledge acquisition, such as resources, personal costs, physical distance, and time [13].

Contemporaneously with an increase in the need for US miners for specialized multidisciplinary care, there is a shortage of experts to fulfill this need [14]. This critical gap is being addressed in New Mexico by innovative technology-based interventions such as mobile clinics equipped for telemedicine [15] and digital communities of practice for knowledge transfer. These interventions are recognized as rural and training innovations by the Rural Health Information Hub and the American Thoracic Society, respectively. The Miners' Wellness ECHO Program is a digital community of practice, defined as a group of people who "share a concern or a passion for something they do and learn how to do better as they interact regularly" [16].

Project ECHO (Extension for Community Health Outcomes) began in 2003 to connect primary care providers in rural New Mexico at “spoke” sites to University-based experts at a “hub” site so the former could effectively treat their patients with Hepatitis C locally, instead of referring them to the University [17]. Since then, the ECHO movement has grown exponentially, spanned many health topics, and reached people around the globe. The Miners' Wellness ECHO Program provides structured longitudinal interprofessional telementoring to professionals caring for US miners in pneumoconiosis mortality hotspots, including respiratory therapists, home health professionals, benefits counselors, attorneys, clinical providers, and others.

Previous research of the Miners' Wellness ECHO established that participants in the pneumoconiosis mortality hot spots in the US valued sessions for delivering relevant, evidence-based, balanced, and objective content [18]. Participants also showed a significant increase in self-efficacy for clinical, medicolegal, and “soft” skills related to miners' health, with “soft” skills including interpersonal and communication skills needed to navigate highly collaborative work in the care of miners [14]. Participants rated the virtual community of practice highly, stating feelings of being “closely knit,” trustworthiness, and willingness to help each other [19].

The foundation of knowledge transfer in the program is the "all teach all learn" model, which implies that every participant has unique knowledge to contribute and share during interprofessional discussions. Our previous research showed that most participants utilized knowledge ties from

outside their participant group, emphasizing the interprofessional nature of knowledge transfer in miners' care [20]. The knowledge transfer was more efficient for participants with greater ties to rural-based miners than those with lesser ties [20]. Given the compensation challenges faced by US miners, benefits counselors and attorneys played an outsized role in knowledge transfer [18].

The objective of our current study was to examine characteristics associated with interprofessional discussions and suggest ways to strengthen knowledge transfer. The long-term goal of this study is to reduce health inequity through greater investment in interprofessional telementoring efforts that promote collaborative health care in medically underserved mining communities by fusing technology with specialized multidisciplinary expertise. This approach may help rural communities counter the re-emergence of the pneumoconiosis epidemic by ameliorating their shortage of skilled expertise in mining-related diseases.

METHODS

ECHO Model

The ECHO approach differs from traditional telemedicine, where providers assume short-term direct care of individual patients. Further, unlike webinars or conventional didactic lectures, the ECHO model provides an interactive discussion of cases with expert panels in real-time that is highly contextualized and thereby fulfills key learning theories, such as deliberate practice [21], social cognitive theory [22], and situated learning and communities of practice [23]. As detailed in a previous publication [18], the ECHO model is based on the following key principles: (1) use of internet-based technology for multipoint videoconferencing, which helps leverage scarce resources; (2) use of an established evidence-based disease-management model that has been demonstrated to improve outcomes by reducing variation in processes of care and sharing best practices [17, 24-26]; (3) use of case-based learning, based on discussion with experts and peers; (4) use of a digital community of practice, which emphasizes reciprocity in the sharing of skills and information; and (5) use of an internet-based database (ie, iECHO software) to monitor outcomes.

Miners’ Wellness ECHO Structure

Professionals involved in miners' health are invited to attend the program using an emailed web link connected to a REDCap survey [27]. As published previously [18], the ECHO sessions are scheduled at the same time twice a month for 75 minutes, adhering to a standard format. Following a facilitator's initial 10 minutes of introduction and announcements, an invited expert delivers a 15-minute didactic followed by a 20-minute facilitated question-answer session and a 30-minute interactive facilitated case discussion. The medical director of the Miners' Wellness ECHO program is trained to facilitate group discussions during a three-day immersion program and is periodically retrained [28]. The ECHO format, employing adult learning principles, focuses more on active learning through discussion than on didactic training. Upon completing a session-specific survey, participants can receive continuing education credits without charge. A multidisciplinary committee of experts follows a structured curriculum that is continually adapted based on the needs of the virtual community of practice, which are identified through a review of the continuing evaluation reports.

Attendance at ECHO sessions is open and voluntary. Through session attendance, participants can participate in the didactic and case discussions, provide information and insight from their own experience, and receive mentoring from their peers and an expert panel. Outside the program sessions, participants continue to have access to peers and experts for urgent consultation requests via telephone or email. Over time, with iterative practice and feedback, participants gain additional

expertise, and become more confident in their skillsets related to caring for miners in their respective fields [14, 18, 20]. Recorded didactic sessions are made available through a web-based archive.

Study Design

This 14-month exploratory sequential mixed methods study involved participants in the Miners' Wellness ECHO Program from July 2018 to September 2019. Together, the University of New Mexico School of Medicine (Albuquerque, NM) and its rural partner Miners' Colfax Medical Center (Raton, NM) constitute the hub site of experts. The spoke partner sites are located across the pneumoconiosis mortality hotspot regions of the US [18]. Although participants were allowed to attend multiple sessions, our analyses emphasize cross-sectional comparisons based on participant characteristics.

We asked the following research questions:

1. Do some participant groups make more utterances than others (e.g., do clinical providers make more utterances than benefit counselors)?
2. Do participants who are more experienced with ECHO have greater rates of active participation in discussion than those with lower levels of experience?
3. Does the participant group identity of the didactic presenter predict active participation in discussion from the same participant group during that session (e.g., if a didactic presenter is an attorney, are other attorneys more likely to participate in discussion in that session)?
4. Does video usage predict active participation in discussion, as compared to audio usage?
5. Does session attendance frequency predict active participation in discussion?

Video Recording and Transcription

Each ECHO session during this study timeframe was video recorded and professionally transcribed. Participants were informed of the recording at the start of each session.

Qualitative Content Analysis

We qualitatively coded interprofessional discussions among ECHO participants in each video. Specifically, we examined participants' verbal utterances, focusing on statements of expertise followed by acceptance or eschewal of the statement(s) by other participants. See Table 1 for the qualitative codebook with definitions of each. See the Appendix for examples of conversations demonstrating statements of expertise and responses of acceptance and eschewal.

We realize that evaluating others' acceptance or eschewal can be subjective and difficult to determine by reading transcripts. Additionally, body language and tone of voice can convey meaning that written words cannot. To minimize these risks, we concurrently coded video recordings of participant behavior alongside transcripts using NVivo 12 (QSR International) and involved a team of four analysts throughout the coding process.

The senior analyst created the preliminary codebook and independently coded the presence of each code across all ECHO sessions. She met with the principal investigator and two other team members to review the trial coding of the first two sessions as a group, modifying coding and definitions as needed. The PI independently reviewed two additional sessions, and the other analysts independently reviewed five sessions; therefore, seven sessions were trial-coded by three (n=5 sessions) or four (n=2 sessions) team members. The team regularly met to discuss coding until they were 100% in agreement, at which point the senior analyst coded the remaining 16 sessions. She continued to meet with the team periodically to discuss her coding generally and anything that was coded to be

"unclear" (as defined in Table 1), at which point they jointly decided on whether it was better suited for another code. We removed all statements of expertise, acceptance, and eschewal of the session facilitator, so we only evaluated participants' utterances.

Quantitative Data Analysis

We worked with our senior statistician (OM) to convert our qualitative coding from NVivo into quantitative coding in Excel and coded additional variables to be analyzed with Statistical Analysis Software (SAS) version 9.4 (SAS Institute Inc, Cary, NC). See Table 1 for the quantitative codebook.

Table 1: Qualitative and quantitative content analysis codebook.

Variable	Variable Label	Variable Code Value	Definition or Example of Code Value	Level of Measurement
Qualitative Codebook				
Utterance type	What type of utterance did the participant make?	1 = Statement of expertise	Defining solutions to problems or answering questions. Anyone who speaks as an expert is an expert.	Nominal
		2 = Acceptance of a statement of expertise	Others' acceptance of a statement of expertise. Includes adding to statement (expanding is acceptance) or verbalizations such as "That's great!" "Thank you so much for that." "That's really helpful!"	
		3 = Eschewal of a statement of expertise	Others' eschewal in response to a statement of expertise. Eschewal can include providing new "expertise" that contradicts statement in disagreement with previously stated opinions/information/evidence/ statements. Can include partial disagreement/eschewal.	
		4 = Neutral or no response to a statement of expertise	Neutral or no response. E.g., if speaker moves to next question/topic.	
Quantitative Codebook				
Number of utterances	How many utterances did the participant make during the session?		Total number of expertise, acceptance, eschewal, or neutral statements during a session.	Ordinal
Participation	Did this person participate in a session?	0 = No 1 = Yes	At least one utterance during a session.	Nominal
Attendance	Did this person attend a session?	0 = No 1 = Yes	Logged into a session.	Nominal
Session	What is the session number?		23 sessions from July 2018 to September 2019	Ordinal
Video	Did the participant use their video camera during the session?	1 = Audio only 2 = Video 3 = Unknown	Use of video camera during a session	Nominal
Presenter	Was the participant a didactic presenter during the session?	0 = No 1 = Yes		Nominal
Participant Group	What participant group was the person a part of?	1 = Attorney 2 = Clinical provider 3 = Home health professional 4 = Respiratory therapist 5 = Benefits Counselor 6= Other	Self-defined participant group status.	Nominal

Participant ECHO Experience Status	What joining group was the person a part of?	1 = Experienced	Participant joined before the start of the study, May 9, 2018.	Nominal
		2 = Intermediate	Participant joined at the start of the study, May 9, 2018.	
		3 = Less experienced	Joined after September 12, 2018.	

Outcome and Predictor Variables

We examined the primary outcome variable, “active participation in discussion,” defined by making any utterances (which included statements of expertise, acceptance, and eschewals). We analyzed the association of the outcome on the following predictor variables: 1) participant group status, 2) study timeframe, 3) participant ECHO experience status, 4) concordance of participant group identity between presenter and participant, 5) video usage, and 6) attendance frequency.

Participant groups included attorneys, benefits counselors, clinical providers, home health professionals, respiratory therapists, and others. The participants’ ECHO experience status was determined by the participant's date of joining the ECHO Program. Participant ECHO experience status was defined by 1) the experienced group: those who joined the Miners' Wellness ECHO before the start of the study, May 9, 2018; 2) the intermediate group: those who joined at the start of the study, May 9, 2018; and 3) the less experienced group: those who joined after September 12, 2018. The participant groups were also classified as "silent" and "vocal" based on their preliminary analysis of their rates of utterances during the ECHO sessions. Participant group identity was considered concordant when the didactic presenter and participant belonged to the same participant group. Video status was determined if the video camera was turned on for any duration during a session by the participant.

Analytic Strategy

The number of utterances by type (statements of expertise, acceptance, and eschewal) and overall for each participant and ECHO session were collected. An average number of utterances by participant group, session and type were computed. Binary variables for any active participation in discussion (1 = Yes for ≥ one utterance in the session, 0 = No for 0 utterances in the session) were made for each utterance type and overall. Frequencies and percentages for active participation variables and other categorical variables were compiled by utterance type, participant group and session.

We used the generalized estimating equations (GEE) approach to extend the generalized linear model to handle longitudinal data, including predictor variables. The logit link function was applied for binary outcomes. Repeated statements with the subject option identified each session as a cluster. LS means were used to compute and compare least squares means of fixed effects. A two-tailed P-value less than 0.05 was considered statistically significant.

Ethics Approval

This study was an arm of a larger study. This arm of the study included participants who consented and enrolled in the larger study and those who were not enrolled in the larger study. This arm was approved as exempt by the institutional review board, University of New Mexico Human Research Protections Office (HRRC#18-386).

RESULTS

Descriptive characteristics

We studied 23 ECHO sessions during the study timeframe, with 158 unique participants and 539 total participants. Seventy-eight (49.4%) participants attended a single session, 28 (17.7%) attended two sessions, 11 (7.0%) attended three sessions, 13 (8.2%) attended 4-5 sessions, 13 (8.2%) attended 6-10 sessions and 15 (9.5%) attended 11-20 sessions (overall mean = 3.4 sessions, *SD* = 4.1). Individual session attendance averaged 23.4 participants per session (*SD* = 5.6, median = 24, IQR = 8, range = 13-36). During these sessions, 23 participants presented 23 patient cases, and 23 invited experts presented 23 didactics.

Do some participant groups make more utterances than others?

Clinical providers, the largest participant group constituting 37% (n=58) of unique participants, were also the most vocal group (21.74 [*SD*=2.11] average utterances per person-session; Table 2). Attorneys, while the smallest group in number (n=11, 7%), were the second most vocal group (6.73 [*SD*=4.29] average utterances per person-session). Benefits counselors and home health professionals were the least vocal groups, with average utterance rates of 0.57 (*SD*=0.29) and 2.86 (*SD=2.24*) per person-session, respectively, constituting 8% (n=13) and 23% (n=36) of unique participants, respectively. Thus, the various participant groups exhibited significantly different rates of utterances across sessions (p-value = 0.003).

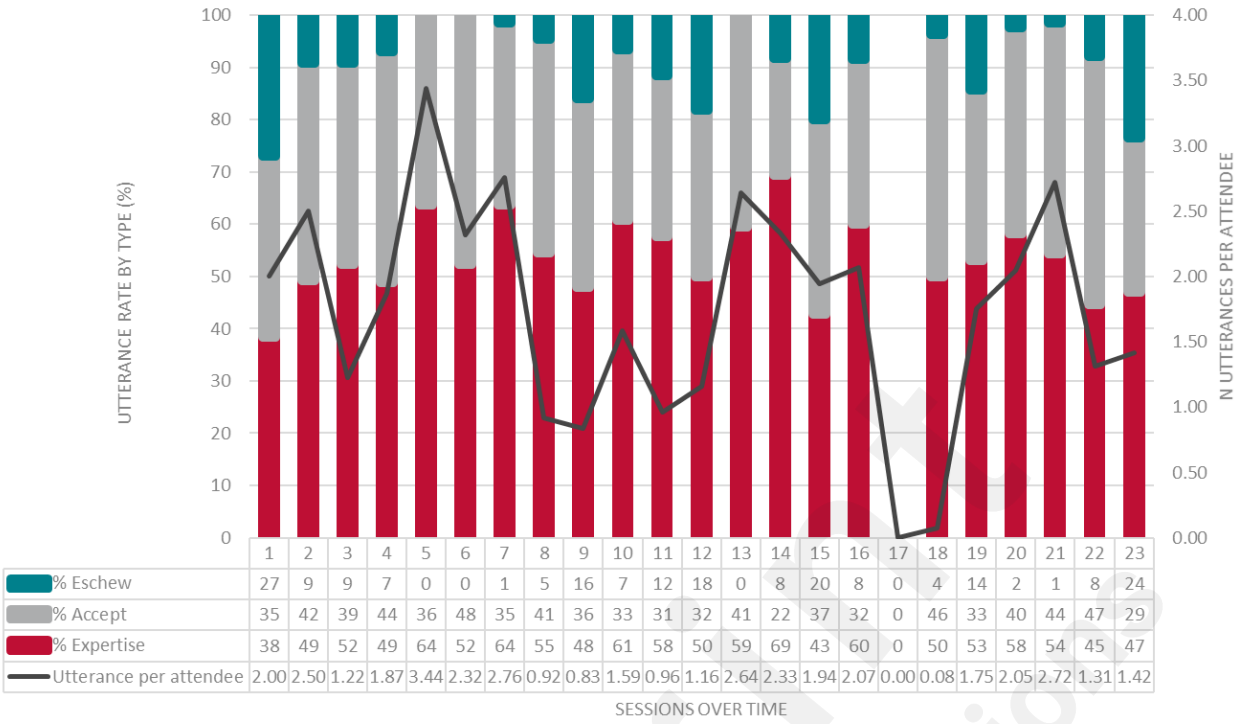
Table 2: Summary of participant groups and their participation in discussion, with utterance rates per person-session across 23 ECHO sessions during the study timeframe.

Participant Group	essionsTotal Participants across	n all sessions% Total Participant	sionsUnique Participants across	ll sessions% Unique participant	Total Statements of Expertise	onAverage expertise per person-	Total Statements of Acceptance	sessionAverage Acceptance per	Total Statements of Eschewal	ionAverage Eschew per person-	sessionsTotal Utterances[a] across	Average Utterances per person-
Attorney	54	10%	11	7%	77	3.50	58	2.64	13	0.59	148	6.73
Benefits Counselor	87	16%	13	8%	6	0.26	7	0.30	0	0.00	13	0.57
Clinical Provider	186	35%	58	37%	280	12.17	182	7.91	38	1.65	500	21.74
Home Health Professional	89	17%	36	23%	36	1.71	21	1.00	3	0.14	60	2.86
Other/Unknown	63	12%	27	17%	56	2.43	48	2.09	7	0.30	111	4.83
Respiratory Therapist	60	11%	13	8%	53	2.30	31	1.35	12	0.52	96	4.17
Total	539	100%	158	100%	508	22.09	347	15.09	73	3.17	928	40.35

[a]Utterances include statements of expertise, acceptance, and eschewal.

Some topics generated a lot of discussion (i.e., high rates of utterances), while others did not (Figure 1). Overall, utterances per person-session did not change over time (p=0.50, Figure 1). It should be noted that in session 17, there were no utterances—this is the only session facilitated by a different person who was an experienced ECHO participant and expert clinical provider but not a trained facilitator. As shown in Table 2, most utterances are statements of expertise, and most statements are accepted. As shown in Figure 1, some topics generate a lot of controversy during discussion (ie, high rates of eschewal), while others do not.

Figure 1: Rates of utterances[a] across ECHO sessions. This figure shows the average number of utterances per person-session (in gray line) and the percentage breakdown of each type of utterance (teal for eschewal, grey for acceptance and red for statements of expertise).



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
% Eschew	27	9	9	7	0	0	1	5	16	7	12	18	0	8	20	8	0	4	14	2	1	8	24
% Accept	35	42	39	44	36	48	35	41	36	33	31	32	41	22	37	32	0	46	33	40	44	47	29
% Expertise	38	49	52	49	64	52	64	55	48	61	58	50	59	69	43	60	0	50	53	58	54	45	47
Utterance per attendee	2.00	2.50	1.22	1.87	3.44	2.32	2.76	0.92	0.83	1.59	0.96	1.16	2.64	2.33	1.94	2.07	0.00	0.08	1.75	2.05	2.72	1.31	1.42

[a]Utterances include statements of expertise, acceptance, and eschewal.

Do participants who are more experienced with ECHO have greater rates of active participation in discussion than those with lower levels of experience?

Experienced and intermediate experienced groups accounted for 36.8% and 26.9% of active participation in discussion, respectively, while the active participation from the less experienced group accounted for 28.6%. Experienced participants may, thus, tend to dominate active participation in discussion compared to participants with less or intermediate levels of experience, but this difference was not statistically significant (p=0.11).

Table 3: Association of participants' ECHO experience with active participation in discussion, as measured by any utterance during an individual session.

Group	N non-active	N active	% active	OR (95% CI.)	p-value	Overall p-value
Experienced	179	104	36.8%	1.45 (0.88, 2.39)	0.14	0.11
Intermediate experience	79	29	26.9%	0.92 (0.52, 1.64)	0.77	
Less experienced	100	40	28.6%	Referent		

Does the participant group identity of the didactic presenter predict active participation in discussion from the same participant group during that session?

Participant group identity was considered concordant when the didactic presenter and participant belonged to the same participant group. For this analysis, the participant groups were categorized as silent vs. vocal, in which the benefits counselors and home health professionals constituted the former group and the clinical providers, attorneys and respiratory therapists in the latter group (with the other/unknown group excluded). When the didactic presenter and participant were from the same participant group, active participation in discussion (measured by any utterances within an individual ECHO session) by the silent group participants was 26.9% compared to 9.5% when the didactic

presenter was from a different group (OR = 3.5, Table 4). Among vocal group participants, active participation was 46.4% when presenters were in the same group as the participant, compared to 46.2% when presenters and participants were from different groups (OR=1.01), with an interaction p=0.003.

Table 4: Association of active participation in discussion by silent and vocal groups on concordance of participant group identity between didactic presenter and participant.

	Vocal group (n=300)				Silent group (n=173)				
Participant group concordance between presenter & participant	N non-active	N active	% Active	OR (95% CI)	N non-active	N active	% Active	OR (95% CI)	interaction p-value
Concordant	111	96	46.4	1.01 (0.58, 1.75)	19	7	26.9	3.5 (1.47, 8.54)	0.003
Discordant	50	43	46.2	Referent	133	14	9.5	Referent	

Note: For this analysis, the participant groups were categorized as silent vs. vocal, in which the benefits counselors and home health professionals constituted the former group and the clinical providers, attorneys and respiratory therapists in the latter group (with the other/unknown group excluded).

Does video usage predict active participation in discussion, as compared to audio usage?

Compared to those joining a session by audio, those joining by video tended to have higher rates of active participation in discussion, as measured by any utterance during an individual session. However, this comparison did not reach statistical significance (Table 5, p=0.11).

Table 5: Association of active participation in discussion on video camera use.

Group	Non-active participation (n)	Active participation (n)	Active Participation (%)	OR (95% CI.)	p-value
Audio	110	54	32.9%	Referent	0.11
Video	175	119	40.5%	1.39 (0.93, 2.07)	

Note 1: Those whose audio and video status could not be determined (n=81) were excluded from the analysis.

Does session attendance frequency predict active participation in discussion?
Unique participants' attendance ranged from 1 to 20 sessions and was categorized into three groups (Table 6). Overall, active participation in the discussion was significantly associated with attendance (p=0.004); however, no dose response was noted.

Table 6: Association of active participation in discussion on frequency of session attendance

Session attendance frequency	Non-active participation (n)	Active participation (n)	Active participation (%)	OR (95% CI.)	p-value	Overall p-value
≤ 5 sessions	76	56	42.4%	Referent		0.004
6-10 sessions	1	12	92.3%	16.3 (2.1, 128.9)	0.008	
11-20 sessions	4	11	73.3%	3.7 (1.1, 12.3)	0.03	

DISCUSSION

In this digital community of practice for managing pneumoconiosis with previously published efficacy outcomes [14, 18, 20], our study findings show that some participant groups are vocal while others are silent, based on utterance rates during interprofessional discussion. Some topics generate a lot of discussion (i.e., relatively high rates of utterances), and some topics generate a lot of

controversy during discussion (i.e., relatively high rates of eschewal of statements of expertise). Inadequately trained facilitators may impede discussion during a session. Experienced participants may dominate the discussion and inhibit participation by less experienced participants, but this association did not reach statistical significance. When the didactic presenter and participant are from the same participant group, participation in discussion by the silent group participants rises significantly. Compared to those participating by audio, those participating by video camera may tend to have higher rates of participation in discussion, but this association did not reach statistical significance. Overall, active participation in the discussion was significantly associated with attendance frequency. Our study findings lend themselves to several best practice recommendations, as discussed below.

The primary objective of the Project ECHO movement is to decentralize knowledge for the care of patients through exchanging insights and information using the all-teach, all-learn principle. All participants have unique knowledge sets, and discussion inside and outside the ECHO session within and across participant groups facilitates the transfer of knowledge that would otherwise remain siloed within individual participant groups. Further, interprofessional discussion in the ECHO model may allow greater access to new and thought-provoking ideas and perspectives that foster learning and other growth-enhancing actions. Our study findings confirm the existence of silent participant groups that, by not fully engaging in discussions, may not be as effective in exchanging knowledge (including providing and acquiring knowledge) within the ECHO session. These groups need to be actively supported by a trained facilitator and by the judicious use of didactic presenters sharing participant group identity concordant with the silent group participants. However, our previous objective measurement of knowledge transfer using social network principles indicates that benefits counselors are among the groups most effective in knowledge transfer [18]. This prior finding would suggest that either benefits counselors convey relevant knowledge succinctly within the ECHO sessions and/or participate in knowledge transfer outside the strict bounds of the ECHO program via follow-up phone calls, emails and virtual and physical meetings.

Project ECHO formally trains its facilitators on the best practices for managing discussions in a digital community of practice. Substituting a trained facilitator by another untrained expert can affect participation in the discussion. Experienced participants usually offer the greatest rates of statements of expertise, acceptance, and eschewal, reflecting their expert status in this complex field. However, the dominance of experienced groups can be avoided by the facilitator actively encouraging less experienced groups to make their minority opinions heard during discussion. Using video cameras during participation in this digital community of practice helps build community and promotes accountability and engagement at the cost of rural Internet bandwidth. This practice should be encouraged, even though the findings did not reach statistical significance.

Our study has multiple strengths. To the best of our knowledge, our approach of studying interprofessional discussion in a digital 'community of practice' for managing pneumoconiosis has never been used previously by another group of investigators. The study involves the innovative ECHO model intervention that addresses barriers to the care of miners by providing a multidisciplinary community of practice approach, which has been well-studied in other diseases [17, 24-26]. This study is topical and significant because it addresses a critical gap related to the emerging pneumoconiosis epidemic in the rural United States. Since no one refused participation, there was likely no potential participation bias in the study. Since the ECHO model has been adopted nationally and globally to care for patients with numerous chronic diseases, infrastructure already exists to rapidly scale the Miners' Wellness ECHO Program nationally and globally. Other strengths include the detailed contemporaneous interpretation of videos and transcripts of discussions, strict quality control in qualitative analysis, a mixed-methods study design, and the simultaneous use of

qualitative, quantitative, and subject content experts as co-investigators. Although our study focused on the ECHO program, our findings have implications for other digital communities of practice.

There are also limitations to this study. We cannot correlate interprofessional discussion for knowledge transfer to patient outcomes or changes in provider behavior. However, we have previously published a listing of qualitative changes our ECHO participants reported they would make in their practice, obtained as part of a CME survey requested at the end of each ECHO session [20]. Although a small sample size raises the possibility of a type I error, individual professionals and teams of professionals trained in the ECHO model can reach a large number of miners, with the potential for creating exponential change.

Conclusions
Our findings provide insight into the mechanics of interprofessional discussion for knowledge transfer in a digital community of practice managing pneumoconiosis and potential recommendations to enhance the same. Our results underscore the capacity of the Project ECHO model to leverage technology and workforce diversity to facilitate interprofessional discussions on the multidisciplinary and complex care of miners and ultimately promote health equity among rural and medically underserved mining communities. Although this approach addresses a critical gap related to the emerging pneumoconiosis epidemic, future research will evaluate whether this translates into improved patient outcomes in mining communities, a priority need in the rural US.

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Data Availability

The data sets generated or analyzed during this study are available from the corresponding author upon reasonable request.

Authors' Contributions

All authors were involved with the following: (1) substantial contributions to the conception or design of the work (HRB, VS, XS, OM, and AS) or the acquisition (HRB, XS, OM, and AS), analysis (HRB, XS, and OM), or interpretation of data for the work (HRB, VS, XS, OM, and AS); (2) drafting the work or reviewing it critically for important intellectual content (HRB, VS, XS, OM, and AS); (3) final approval of the version to be published (HRB, VS, XS, OM, and AS); and (4) agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved (HRB, VS, XS, OM, and AS).

Conflicts of Interest

None declared.

Abbreviations

US: United States
CME: continuing medical education
ECHO: Extension for Community Health Outcomes
REDCap: Research Electronic Data Capture
GEE: generalized estimating equations
SAS: Statistical Analysis Software
SD: standard deviation
OR: odds ratio
CI: confidence interval

REFERENCES

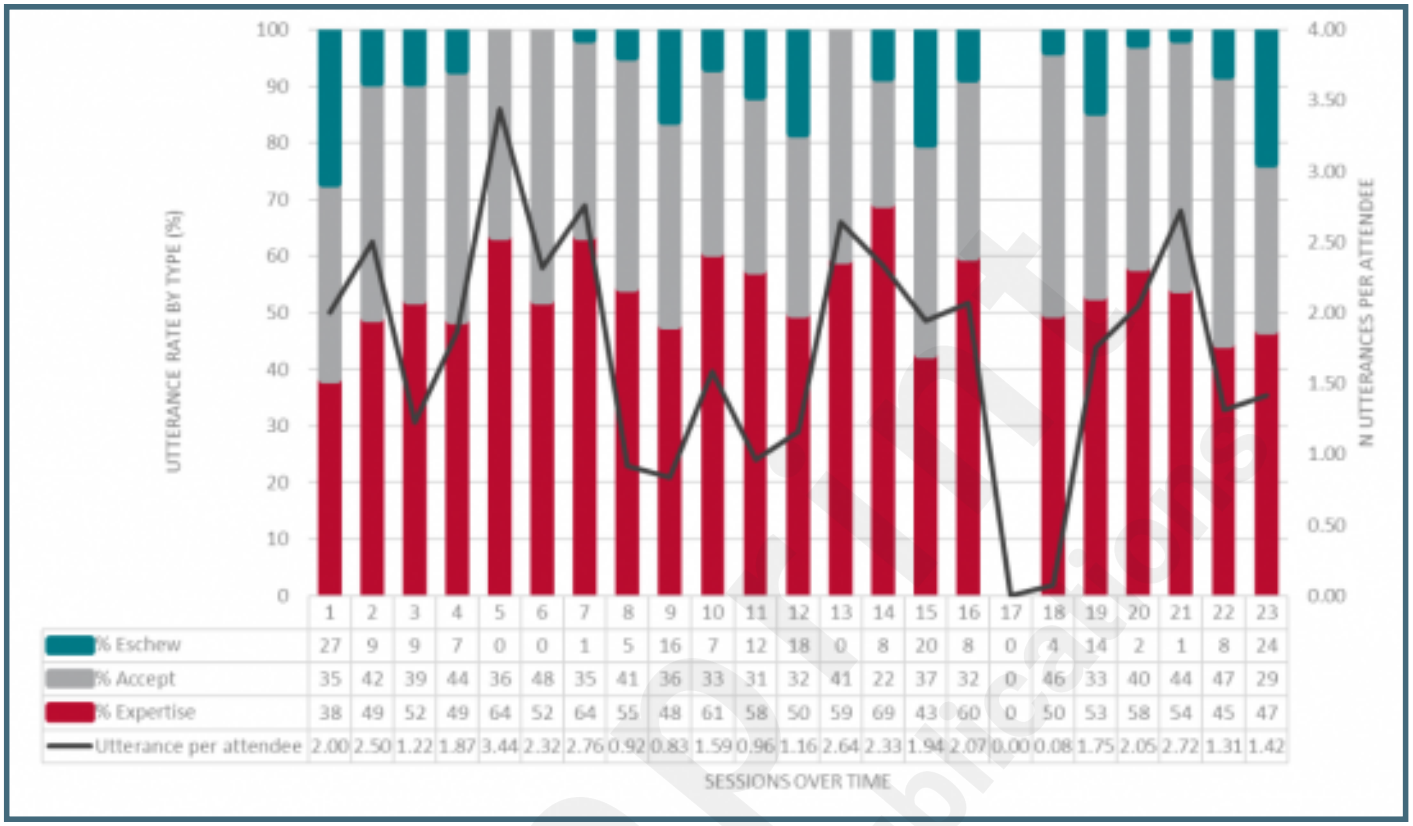
1. Blackley DJ, Halldin CN, Laney AS. Continued Increase in Prevalence of Coal Workers' Pneumoconiosis in the United States, 1970-2017. American journal of public health. 2018 Sep;108(9):1220-2. PMID: 30024799. doi: 10.2105/AJPH.2018.304517.
2. Hall NB, Blackley DJ, Halldin CN, Laney AS. Continued increase in prevalence of r-type opacities among underground coal miners in the USA. Occupational and environmental medicine. 2019 Jul;76(7):479-81. PMID: 31023786. doi: 10.1136/oemed-2019-105691.
3. Laney AS, Attfield MD. Coal workers' pneumoconiosis and progressive massive fibrosis are increasingly more prevalent among workers in small underground coal mines in the United States. Occupational and environmental medicine. 2010 Jun;67(6):428-31. PMID: 20522823. doi: 10.1136/oem.2009.050757.
4. Laney AS, Blackley DJ, Halldin CN. Radiographic disease progression in contemporary US coal miners with progressive massive fibrosis. Occupational and environmental medicine. 2017 Jul;74(7):517-20. PMID: 28408654. doi: 10.1136/oemed-2016-104249.
5. Blackley DJ, Halldin CN, Laney AS. Resurgence of a debilitating and entirely preventable respiratory disease among working coal miners. American journal of respiratory and critical care medicine. 2014 Sep 15;190(6):708-9. PMID: 25221884. doi: 10.1164/rccm.201407-1286LE.
6. Dwyer-Lindgren L, Bertozzi-Villa A, Stubbs RW, Morozoff C, Shirude S, Naghavi M, et al. Trends and Patterns of Differences in Chronic Respiratory Disease Mortality Among US Counties, 1980-2014. Jama. 2017 Sep 26;318(12):1136-49. PMID: 28973621. doi: 10.1001/jama.2017.11747.
7. Almberg KS, Halldin CN, Blackley DJ, Laney AS, Storey E, Rose CS, et al. Progressive Massive Fibrosis Resurgence Identified in US Coal Miners Filing for Black Lung Benefits, 1970-2016. Annals of the American Thoracic Society. 2018 Dec;15(12):1420-6. PMID: 30114941. doi: 10.1513/AnnalsATS.201804-261OC.
8. Arnold C. A Scourge Returns: Black Lung in Appalachia. Environmental health perspectives. 2016 Jan;124(1):A13-8. PMID: 26720594. doi: 10.1289/ehp.124-A13.
9. Fan VS, Giardino ND, Blough DK, Kaplan RM, Ramsey SD, Nett Research G. Costs of pulmonary rehabilitation and predictors of adherence in the National Emphysema Treatment Trial. Copd. 2008 Apr;5(2):105-16. PMID: 18415809. doi: 10.1080/15412550801941190.
10. Kirby JB, Yabroff KR. Rural-Urban Differences in Access to Primary Care: Beyond the Usual Source of Care Provider. Am J Prev Med. 2020 Jan;58(1):89-96. PMID: 31862103. doi: 10.1016/j.amepre.2019.08.026.
11. Croft JB, Lu H, Zhang X, Holt JB. Geographic Accessibility of Pulmonologists for Adults With COPD: United States, 2013. Chest. 2016 Sep;150(3):544-53. PMID: 27221645. doi: 10.1016/j.chest.2016.05.014.
12. Miedema B, Hamilton R, Fortin P, Easley J, Tatemichi S. The challenges and rewards of rural family practice in New Brunswick, Canada: lessons for retention. Rural and remote health. 2009 Apr-Jun;9(2):1141. PMID: 19496642.
13. Crockett LK, Leggett C, Curran JA, Knisley L, Brockman G, Scott SD, et al. Knowledge sharing between general and pediatric emergency departments: connections, barriers, and opportunities. CJEM. 2018 Feb 22:1-9. PMID: 29467040. doi: 10.1017/cem.2018.7.
14. Sood A, Pollard C, Kalishman S, Assad N, LeSuer K, Khattar R, et al. Telementoring of Healthcare Teams in the Care of Miners. ATS Sch. 2020 Dec 22;2(1):66-83. PMID: 33870324. doi: 10.34197/ats-scholar.2020-0073OC.
15. Evans K, Lerch S, Boyce TW, Myers OB, Kocher E, Cook LS, et al. An Innovative Approach to Enhancing Access to Medical Screening for Miners using a Mobile Clinic with Telemedicine Capability. Journal of health care for the poor and underserved. 2016;27(4A):62-72. PMID:

27818414. doi: 10.1353/hpu.2016.0182.
16. Wenger E. Communities of Practice: Learning, Meaning and Identity. Cambridge, UK: Cambridge University Press; 1998.
17. Arora S, Thornton K, Murata G, Deming P, Kalishman S, Dion D, et al. Outcomes of treatment for hepatitis C virus infection by primary care providers. The New England journal of medicine. 2011 Jun 09;364(23):2199-207. PMID: 21631316. doi: 10.1056/NEJMoa1009370.
18. Sood A, Assad N, Jarrell W, Kalishman S, Le Suer K, Murillo S, et al. A virtual community-of-practice approach by rural stakeholders in managing pneumoconiosis in the USA: a cross-sectional analysis. Rural Remote Health. 2020 Aug;20(3):5784. PMID: 32847365. doi: 10.22605/RRH5784.
19. Files JA, Blair JE, Mayer AP, Ko MG. Facilitated peer mentorship: a pilot program for academic advancement of female medical faculty. J Womens Health (Larchmt). 2008 Jul-Aug;17(6):1009-15. PMID: 18681821. doi: 10.1089/jwh.2007.0647.
20. Soller B, Myers O, Sood A. Transfer of Knowledge on Pneumoconiosis Care Among Rural-Based Members of a Digital Community of Practice: Cross-Sectional Study. JMIR Form Res. 2024 Jan 24;8:e52414. PMID: 38265861. doi: 10.2196/52414.
21. Ericsson KA. Deliberate practice and acquisition of expert performance: a general overview. Acad Emerg Med. 2008 Nov;15(11):988-94. PMID: 18778378. doi: 10.1111/j.1553-2712.2008.00227.x.
22. Bandura A. Social cognitive theory: an agentic perspective. Annu Rev Psychol. 2001;52:1-26. PMID: 11148297. doi: 10.1146/annurev.psych.52.1.1.
23. Wenger E. How we learn. Communities of practice. The social fabric of a learning organization. Healthc Forum J. 1996 Jul-Aug;39(4):20-6. PMID: 10158755.
24. Arora S, Kalishman S, Thornton K, Dion D, Murata G, Deming P, et al. Expanding access to hepatitis C virus treatment--Extension for Community Healthcare Outcomes (ECHO) project: disruptive innovation in specialty care. Hepatology. 2010 Sep;52(3):1124-33. PMID: 20607688. doi: 10.1002/hep.23802.
25. Bouchonville MF, Hager BW, Kirk JB, Qualls CR, Arora S. Endo Echo Improves Primary Care Provider and Community Health Worker Self-Efficacy in Complex Diabetes Management in Medically Underserved Communities. Endocr Pract. 2018 Jan;24(1):40-6. PMID: 29368967. doi: 10.4158/EP-2017-0079.
26. Deming P, Arora S. Taribavirin in the treatment of hepatitis C. Expert opinion on investigational drugs. 2011 Oct;20(10):1435-43. PMID: 21854301. doi: 10.1517/13543784.2011.606214.
27. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap) - A metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform. 2009 Apr;42(2):377-81. PMID: 18929686. doi: 10.1016/j.jbi.2008.08.010.
28. Moss P, Hartley N, Russell T. Project ECHO((R)): a global cross-sectional examination of implementation success. BMC Health Serv Res. 2024 May 3;24(1):583. PMID: 38702685. doi: 10.1186/s12913-024-10920-5.

Supplementary Files

Figures

Rates of utterances across ECHO sessions. This figure shows the average number of utterances per person-session (in gray line) and the percentage breakdown of each type of utterance (teal for eschewal, grey for acceptance and red for statements of expertise).



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
% Eschew	27	9	9	7	0	0	1	5	16	7	12	18	0	8	20	8	0	4	14	2	1	8	24
% Accept	35	42	39	44	36	48	35	41	36	33	31	32	41	22	37	32	0	46	33	40	44	47	29
% Expertise	38	49	52	49	64	52	64	55	48	61	58	50	59	69	43	60	0	50	53	58	54	45	47
Utterance per attendee	2.00	2.50	1.22	1.87	3.44	2.32	2.76	0.92	0.83	1.59	0.96	1.16	2.64	2.33	1.94	2.07	0.00	0.08	1.75	2.05	2.72	1.31	1.42

Multimedia Appendixes

Interprofessional Discussion for Knowledge Transfer in a Digital 'Community of Practice' for Managing Pneumoconiosis: A Mixed Methods Study.
URL: http://asset.jmir.pub/assets/9fe37986b9a0e42afd9a2e97b13116bb.docx