SCIENTIFIC ARTICLE

A Systematic Review of Utilities in Hand Surgery Literature

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Purpose To systematically review the literature to determine if utilities (a quantitative way to express patient preferences for health outcomes) have been measured in hand surgery studies.

Methods A literature search was conducted using Cochrane, EMBASE, HealthSTAR, MEDLINE, and CINAHL electronic databases (1966–2013). This search was supplemented by cited and manual reference searches and expert consultation to retrieve all relevant studies. Studies were selected by 2 independent reviewers if they pertained to hand or wrist surgery, were published in English, and measured utilities as an outcome. Descriptive data were extracted, including the hand surgery procedure investigated, study design, value of utilities, and methodology of utilities measurement.

Results Eleven studies were included after reviewing 989 studies. Most hand conditions were associated with utilities less than 0.8. Utilities in the reviewed studies were measured using different methods and from different subjects. Three studies paradoxically mapped greater utilities for poorer heath states.

Conclusions Hand conditions cause impairment, as evidenced by their utilities. Measurement of utilities remains uncommon in hand surgery literature. Future studies should not only measure utilities but also do so with consistent and appropriate methodology to ensure that mapped values are valid and comparable. *(J Hand Surg Am. 2015;■(■):■–■. Copyright © 2015 by the American Society for Surgery of the Hand. All rights reserved.)*

Type of study/level of evidence Economic/decision analysis III.

Key words Hand, preferences, quality-adjusted life years, quality of life, utilities.

With growing emphasis on evidence-based medicine, the hand surgeon is often tasked with appraising different surgical techniques to justify their adoption or continued use. To evaluate these interventions, hand surgery studies have traditionally measured surgical outcomes such as strength, function, and pain. Whereas surgeons have long recognized these outcomes as measures of surgical success, their importance may not always hold the same value for patients.[1]

Would a gain in 20° of range of motion of the proximal interphalangeal joint of the index finger following surgery hold the same value for a musician who still could not return to playing piano? Likewise, would a 0.5-kg gain in grip strength be satisfactory for a patient who still experienced difficulties with basic activities of daily living? Differences in how disease and disability are perceived by the hand surgeon and experienced by the patient can make assessing the true impact of hand conditions and interventions difficult.[1]

To better understand the impact of hand conditions and interventions on patients, there is now greater emphasis on measuring a patient's physical, mental,

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TABLE 1. Utility Measurement Methods

	Methods	Valuation
Direct	VAS	Utilities are based on the valuation of a particular health state by subjects marking on a line from 0 (corresponding to death) to 1 (corresponding to perfect health).
	TTO	Subjects balance 2 outcomes, a certain number of years in a less desirable health state and variable reduction in lifespan but with full health. Utilities are based on the ratio of these 2 values, with the latter used as the numerator.
	SG[4]	Subjects balance 2 outcomes, the variable probability of full health "x" and death "1-x," and the 100% certainty of a less desirable health state. Utilities are based on the probability "x" at which point subjects consider the 2 strategies equivalent.
Indirect	EQ-5D,[9] SF-6D,[10] HUI,[11,12] QWB,[13] 15D,[14] Rosser Index[15]	Subject's functioning in one or more health domains are converted to utilities based on instrument-specific formulas, which were derived from directly measured utilities from large populations.

MAU, multi-attribute utility; QWB, quality of well-being scale.

emotional, and social well-being as a surgical outcome.[1] Collectively, this outcome is referred to as the patient's "quality of life" (QOL). One way to capture QOL is through the measurement of health utilities.[1–5] Health utilities are a quantitative method of representing a particular health state on a scale of 0 (death) to 1 (perfect health).[6,7] The numerical value of a utility score represents both the overall quality of and the patient preference for the health state in question. Utilities can also be integrated with QOL to produce quality-adjusted life years data by multiplying the utility gain after surgery with the amount of life remaining after the intervention.[2] Various methods have been suggested to measure utilities in either prospective studies or decision analyses[6,8] (Table 1).

In hand surgery studies, measuring utilities as an outcome is, therefore, a means of accurately quantifying the QOL impact of hand conditions and their corrective surgeries.[2,16] When combined with cost data, utilities also facilitate economic analyses of hand surgery techniques or technologies to determine their societal worth.[17] Lastly, as an outcome that can be measured for all types of interventions, utilities serve as a common metric by which comparisons between hand surgeries and surgeries in other specialties can be made.

In 2004, a systematic review highlighted the paucity of utilities measurement in all surgical studies, particularly those of plastic surgery, leading the authors to conclude that greater universal awareness and measurement of utilities was needed.[2] Since this publication, numerous articles have also been published to raise awareness and educate hand surgeons regarding utilities.[1,3–6,8] Nearly a decade later, how have we responded?

The primary objective of this study was to determine if utilities have been measured in hand surgery studies. The secondary objectives were to determine how utilities were measured in these studies and, if appropriate, to aggregate the collected data into an index of utilities specific to hand conditions and surgeries.

MATERIALS AND METHODS

A literature search was conducted in the Cochrane, EMBASE, HealthSTAR, MEDLINE, and CINAHL electronic databases (January 1966–May 2013). The key terms searched were hand surgery, hand, wrist, cost-benefit analysis, quality-adjusted life years, standard gamble (SG), time trade-off (TTO), EuroQol 5d (EQ-5D), Rosser Index, Quality of Well-Being Scale, and Health-Utilities Index (HUI). Search strategies were individualized to each electronic database to ensure comprehensive searches. The Preferred Reporting Items for Systematic Reviews and Meta-Analysis guidelines (www.prisma-statement.org) were followed as appropriate.

Titles, abstracts and full articles were independently reviewed by 2 reviewers (Y.K.L. and N.A.). Inclusion criteria consisted of studies that pertained to hand surgery, were published in English, and measured utilities as an outcome. We considered hand surgeries as all surgeries involving the hand and wrist. This review process was supplemented by cited and manual reference searches and consultation with

TABLE 2. MINORS Scale

1. Clearly stated aim
2. Inclusion of consecutive patients
3. Prospective collection of data
4. End points appropriate
5. Unbiased assessment of the study end point
6. Follow-up period appropriate to the aim of the study
7. Loss to follow-up < 5%
8. Prospective calculation of the study size
9. An adequate control group
10. Contemporary groups
11. Baseline equivalence of groups
12. Adequate statistical analysis

Scoring System

Not reported, 0; reported but inadequate, 1; reported and adequate, 2.
Maximum score: 16 (noncomparative studies), 24 (comparative studies).

(Adapted with permission from Slim K, Nini E, Forestier D, et al. Methodological index for non-randomized studies (MINORS): development and validation of a new instrument. *ANZ J Surg*. 2003;73(9):712–716. Copyright © 2003 John Wiley & Sons.)

TABLE 3. Appraisal of Decision Analyses

1. Was a focused PICOT clinical question used?
2. Was an *a priori* literature review conducted to identify all clinically relevant treatment strategies and outcomes?
3. Was an explicit and sensible process used to select and combine the evidence into probabilities?
4. Were utilities obtained in an explicit and sensible way from credible sources?
5. Was a decision tree illustrated to show all clinically relevant treatment strategies and outcomes?
6. Were sensitivity analyses conducted to identify the impact of any uncertainty in outcome probabilities and utilities?

PICOT, population, intervention or variable of interest, comparison, outcome, time frame.

the senior author (A.T.) to ensure retrieval of all studies of interest. Interreviewer variability was assessed and disagreements were resolved through consensus. Relevant data were extracted using a data collection form developed *a priori*.

The methodological quality of the included studies was assessed using a modified Jadad scale[18] for randomized controlled trials (RCTs) and the Methodological Index for Non-Randomized Studies scale[19] (Table 2) for observational studies. The Jadad scale was modified because it is often not possible to blind both surgeons and patients to surgical technique. Studies, therefore, received one point for the question "Was the study described as double-blinded?" if the outcome assessor(s) was blinded.[20] Because no quality assessment tool currently exists for decision analyses, a published guide on the critical appraisal of these studies was used to develop a framework for further analysis[21] (Table 3). Decision analyses, in brief, investigate hypothetical clinical scenarios in which all interventions and their expected consequences are considered. Further details on decision analyses are beyond the scope of this review but can be found in other articles.[4,5,22,23]

RESULTS

A total of 989 studies were identified through the search strategy and reviewed (Fig. 1). Among these, 3 studies[24–26] published data on the same study subjects and were grouped together. Eleven studies comprising 6 decision analyses,[24–31] 2 RCTs,[3,32] 2 prospective case series,[33,34] and 1 retrospective cohort study[35] met the inclusion criteria and were included in the review. Interreviewer agreement for title and abstract screening and full-text review was excellent (kappa = 0.9).

Quality assessment

Review of the 6 decision analyses found that most studies had a clear research question, provided a decision tree to illustrate treatment arms and outcomes, and performed sensitivity analyses.[25,27–31] Shortcomings, however, were identified in other methodological areas. Although all studies reviewed the literature to identify which outcomes should be included in the decision analyses, only 2 did so in a systematic fashion.[24,31] As well, in all 6 studies, probabilities for the included outcomes were either subjectively or unclearly determined, potentially introducing measurement bias. Overall, the methodological quality of the decision analyses was moderate.

Both RCTs, in contrast, demonstrated excellent methodological quality.[3,32]

Randomization, blinding, and description of withdrawals and drop-outs were adequate. The 3 observational studies also demonstrated good quality.[33–35] The lone comparative study scored 20 (maximum, 24) and the other 2 noncomparative studies scored greater than 10 (maximum, 16). Common problems included a lack of assessor blinding,[33–35] loss to follow-up greater than 5%,[33,35] and no *a priori* sample size calculation.[33,35]

Utilities assessment

Utilities of various hand conditions and the respective surgical interventions were investigated (Table 4). Five studies investigated endoscopic or open release of

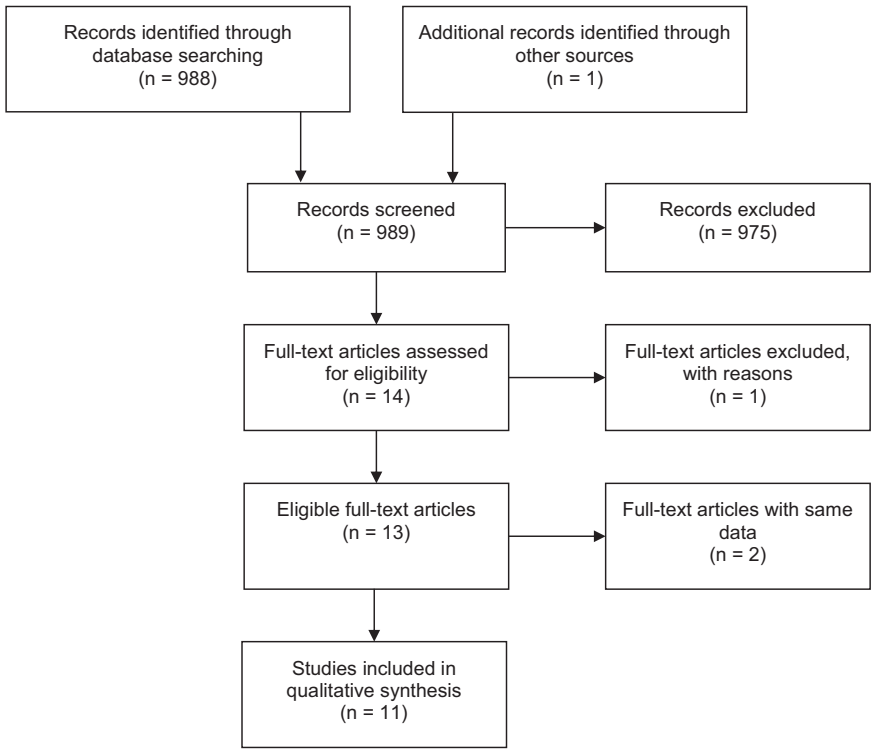

FIGURE 1: Flow of literature search.

carpal tunnel syndrome.[3,27,32,33,35] Two studies investigated hand amputation and hand transplantation.[28,30] One study investigated open reduction and internal fixation of scaphoid fractures.[29] One study investigated total wrist arthroplasty and arthrodesis of the rheumatoid wrist.[24–26] One study investigated Dupuytren disease and partial fasciectomy.[31] The type of hand surgery investigated was not specified in one study as surgeries were broadly classified as "elbow/hand."[34]

Direct measurement methods were used in 6 studies. Specifically, visual analog scale (VAS)[27] and SG[31] were used in 1 study each and TTO in 4[25,28–30] (Table 1). For indirect methods, HUI was used in 1 study,[3] EuroQol 5D (EQ-5D) in 2 (32,34), and Short Form 6D (SF-6D) in 1[33] (Table 1). One study[35] adopted utilities from a previous study[27] and did not measure them.

In the 6 decision analyses, utilities were measured from nurses, hand therapists, physicians, medical students, the general public, and proxy patients with similar demographics to surgical candidates.[25,27–31] One decision analysis measured utilities from both patients and physicians.[25,26] In the remaining 5 studies, utilities were measured from patients undergoing surgery.[3,32–35]

Evaluation of mapped health utilities revealed that most hand conditions assessed had utilities of less than 0.80, with painful rheumatoid wrist (0.41) demonstrating the worst utility value and Dupuytren disease the highest (0.98). Corrective surgery without complications generally improved the utilities of hand conditions. The one exception was unilateral hand transplantation, in which prosthetic use without surgery was favored by study subjects and associated with greater utility (0.75 and 0.72, respectively) (Table 4).

In 3 decision analyses, analysis of measured utilities revealed concerning paradoxical findings in that greater utilities were mapped for poorer health states.[25,27,29] In Chung et al,[27] carpal tunnel release complicated by finger numbness for 3 months (0.81) was deemed to be a better health state than the same procedure without complications (0.78). In Davis et al,[29] scaphoid open reduction internal fixation complicated by infection (0.80) was deemed to be a better health state than scaphoid open reduction internal fixation without complications (0.79). In Cavaliere at al[24–26] total wrist arthrodesis with minor, intermediate, or major complications (0.59, 0.55, and 0.54, respectively) were deemed by patients to be better health states than the same procedure without complications (0.51), as was total wrist arthroplasty with intermediate complications (0.70) over the same procedure without complications (0.68). In addition, this paradoxical pattern was also found among utilities measured from physicians, in that total wrist arthrodesis

TABLE 4. Select Mapped Utilities

Health State	Utility	Method	Perspective
Rheumatoid wrist	0.41	TTO	Patients
	0.55	TTO	Physicians
Total wrist arthrodesis	0.51	TTO	Patients
	0.80	TTO	Physicians
Total wrist arthroplasty	0.68	TTO	Patients
	0.55	TTO	Physicians
Carpal tunnel syndrome	0.69	SF-6D	Patients
Carpal tunnel release	0.77	SF-6D	Patients
	0.78	VAS	Residents, hand therapists, and nurses
	0.85	EQ-5D	Patients
Dupuytren contracture	0.987	SG	General public
Open partial fasciectomy	0.991	SG	General public
Unilateral hand amputation	0.75	TTO	Medical students
Unilateral hand transplantation	0.72	TTO	Medical students
Bilateral hand amputation	0.63	TTO	Medical students
Bilateral hand transplantation	0.69	TTO	Medical students

or arthroplasty without complications were deemed worse health states than the same procedure with complications.

DISCUSSION

The main objective of this study was to determine if utilities were measured in hand surgery studies. Our review found that they were, although uncommonly, because only 11 relevant studies were identified. Our secondary objectives were to assess how the utilities were measured and aggregate mapped utilities in hand surgery literature into an index, if appropriate to do so. Establishing an index of utilities has been successfully done before in domains other than hand surgery.[36–41] Such an index would allow various hand conditions and surgeries to be ranked according to their impact on QOL. Collected utilities would also facilitate comparisons with other medical conditions and surgical interventions. We were, however, unable to achieve this objective because there was marked heterogeneity in the measurement of utilities across the studies. Ranking or grouping these utilities into an index was, therefore, inappropriate.

Mapped utilities were first derived from an array of measurement methods. Because there is inherent variation in each measurement method, utilities measured using one method may not be directly comparable to those measured by another. For instance, utilities measured by TTO are generally less than those measured by SG.[42] This is because the SG technique requires patients to consider odds that may be conceptually harder to grasp and the risk of death, which may overvalue health states (Table 1). Established questionnaires such as SF-6D and EQ-5D also differ, because both instruments have distinct descriptive systems for health dimensions and formulas to derive utilities.[43] SF-6D thus maps values from 0.296 to 1.0[10] whereas EQ-5D maps from −0.594 to 1.0.[9]

Second, utilities were also measured from different cohorts of subjects, further adding to the heterogeneity and variation in the data. For example, utilities measured from patients may be greater than those from nonpatients for the same health states.[44,45] This is based on the rationale that patients may have positively adapted to their chronic health state and thus experience a better QOL than perceived by others.[44,45]

In addition to the aforementioned issues, we also identified paradoxical results in 3 studies in which poorer health states were assigned greater utilities.[25,27,29] Because it is illogical why anyone would prefer poorer health states, one can only assume that these 3 studies sustained methodological errors, casting doubt on the validity of their mapped utilities. Errors could have been multifactorial, possibly at the study subject and/or investigator level. At the study subject level, health states may not have been adequately understood or questionnaires may not have

been correctly completed. At the investigator level, health states may not have been adequately described, utility instruments may not have been correctly administered, or results may have been incorrectly transcribed.

Although we were not able to establish an index of utilities for hand conditions and hand surgeries, analyzing the collected data did allow for some conclusions. Foremost, hand conditions cause impairment and can have a major influence on patients' QOL, because most measured hand conditions had utilities less than 0.80. In perspective, utilities for blindness, tetraplegia, lower leg amputation, liver transplantation, and kidney transplantation have been mapped at 0.26, 0.46, 0.67, 0.73, and 0.83, respectively.[46–50] Second, patients' lives almost always benefited from surgical intervention, except for unilateral hand transplantation, in which lifelong immunosuppressive therapy and its associated adverse events outweighed the benefits of prosthesis without surgery. This reinforces the notion that surgery may not always be favorable to the patient, because the consequences of surgery may have a stronger and more negative impact on QOL. Third, Dupuytren contracture was not found to have a significant effect on patient QOL, because mapped utilities were 0.99 both before and after palmar fasciectomy in the decision analysis by Chen et al.[31] One possible explanation is that Chen et al[31] used the SG technique, which as aforementioned can result in overvalued utilities. The study also collected utilities from the general public rather than patients, and it may be difficult for the public to understand the disability associated with digital flexion contractures. Lastly, the SG technique employed by Chen et al[31] may not have been sensitive enough, because all described health states were between 0.97 and 0.99. The findings in Chen et al[31] are not congruent with those from a study by the senior author (A.T.) et al,[51] in which the gain in prospectively measured utilities using HUI after palmar fasciectomy was 0.03 at one year (0.80–0.83). It seems, from this in-press study and clinical experience with this disease, that Dupuytren fasciectomy has a greater impact on QOL than what has been reported.

Another key observation is that there remains a paucity of data on utilities in hand surgery literature. It would be useful to quantify the impact that conditions such as hand osteoarthritis, digital amputations, and tendon injuries have on patients' QOL and the change in utilities after undergoing corrective surgery. It would also be ideal if utilities were measured directly from actual patients in prospective or RCT study designs rather than decision analyses.[3] Of the 11 studies included in our review, more than half were decision analyses. Decision analyses are performed under conditions of uncertainty and are often fraught with assumptions that can bias the measurement of utilities. These studies should, therefore, be ideally limited to scenarios whereby clinical studies are not ethically or practically possible.

Of the 11 studies included in our review, 7 originated from the United States and 1 from Canada. Of these 8 studies, 5 were affiliated with Chung.[25–27,29,31]

While Chung et al's efforts[25–27,29,31] should be commended, these findings indicate that, worldwide, study investigators are not routinely measuring utilities. This is discouraging given that numerous articles have been published to educate surgeons and researchers in this area over the past decade.[1,3–6,8] Moreover, nearly all of the included studies were published in journals with an impact factor greater than one, including *Plastic and Reconstructive Surgery* and the *Journal of Hand Surgery*. Because this would be the expected literature that hand surgeons read, there is certainly not a lack of exposure to the concept of utilities.

Several recommendations can be put forth. Foremost, there is certainly a need for surgeon investigators to familiarize themselves with the concept of utilities, and guidance can be found in numerous publications.[1,3–6,8] Journal editors, conversely, should encourage and support studies measuring utilities.[2]

Investigators should also ensure that mapped utilities are valid. If utilities are measured using direct methods, investigators should first pilot-test their surveys to ensure that they are clear, comprehensive, and sensitive to different health states. To allow precise evaluation of QOL or utilities in decision analyses, health states should be described as accurately as possible, including the age at disease onset, severity of disease, duration of health state, and prognosis. Furthermore, it would be prudent to educate study subjects regarding utilities and the methods used to measure them. It may be informative for subjects to first complete a VAS questionnaire that is conceptually less challenging before proceeding with TTO or SG surveys, because this would acclimatize subjects to evaluating health states and avoid measurement errors or bias. Measurement errors or bias could also be avoided if interviews were conducted by individuals with training and expertise in this area.[2] Expertise can be acquired, for instance, through watching instructional videos on how to properly assess health-state preference.[52] Utilities can be measured using direct methods from both patients (in prospective studies) and members

of the general public (in prospective studies or decision analyses).

An alternative to direct methods of measurement would be for researchers to use generic utility instruments such as EQ-5D, SF-6D, and HUI. Utilities in this fashion would be measured from patients as part of prospective study, with subjects asked to complete questionnaires before surgery to assess baseline values and at several points after surgery to assess change. For researchers newly engaged in this field or without access to a trained research assistant, this may be the best option to measure utilities. Although generic utility instruments are both more time- and cost-effective to administer relative to the VAS, TTO, or SG techniques, they come with the disadvantage that they are not designed specifically for hand conditions. They may, therefore, lack the precision to discriminate small differences in utilities in hand surgery patients.

In the future, the use of a hand-specific utility instrument may be the best option to measure utilities in hand surgery studies. Disease-specific utility instruments have been successfully created before in other medical specialities.[53–55] Such an instrument would standardize the measurement of utilities. It would also negate the variation in utilities that arise from using different measurement methods. To our knowledge, however, no such instrument exists or is in development. Creation of such a tool is, therefore, a worthwhile area for further research.

It may also be valuable to consider computer-based health preference elicitation. Many programs, such as Program to Survey Preferences by Evaluating Quality of Life Tradeoffs[56] and Internet Multimedia Preference Assessment Instrument Construction Tool Version 4,[57,58] have been developed for the purpose of measuring utilities.[59] Computer-based utilities measurement may be favorable to study investigators because they obviate the need for an in-person interview or a trained assistant.[60] Real-time computer processing also negates potential bias introduced by interviewers, human errors in handling study data, and scenarios whereby greater utilities are mapped for worse health states and vice versa, because subjects would be automatically prompted to reconsider their responses.[60] With que easily accessible through the Internet, study subjects are afforded greater flexibility and convenience, and this may improve subject compliance and response accuracy as well.[60]

Finally, future studies should avoid measuring utilities from physicians or medical students but rather use those from the general public or patients.[61] The importance of using patients is that they are expected to display a unique sensitivity to the benefits and risks associated with the intervention being measured. Their perspectives are influenced by their experience with disease, which invariably affect their preferences for particular health states.[44,45] Although the general public may not accurately represent patients suffering from an illness, measurement of utilities from the societal perspective has been advocated by the Panel on Cost-Effectiveness in Health and Medicine.[61] If the general public are used, then care should be taken to ensure that they are a representative sample of the population.[1,60]

We strongly believe that hand surgeons should have a vested interest in measuring utilities. In an age when there are limited health care resources and competition for these scarce resources, utilities can be an objective means of showing policy makers that hand surgeries are just as, or even more, impactful than procedures in other surgical specialties. Carpal tunnel surgery, for instance, compares favorably with cataract surgery and knee arthroplasty, as all 3 have reported utility gains of 0.08.[33,62,63] This information can subsequently be relayed by hand surgeons to policy makers to lobby for more resources, benefiting both service to patients and the specialty itself. Measured utilities can also be integrated with cost data to perform economic analyses of hand surgeries. These analyses can help refine the specialty because they can be used to identify which techniques should be adopted or abandoned depending on their cost-effectiveness.

Our review was able to summarize the existing measurement of utilities in hand surgery literature. Unfortunately, data are scarce on this important outcome measure, and early work over the past decade has been fraught with inconsistencies and methodological errors in utilities measurement. Given the vast potential of utilities as a research tool in therapeutic studies and economic evaluations, we strongly encourage hand surgeons and researchers to measure utilities in their research, consider our recommendations, and continue refining their work in this area.

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