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Original Research Article

# Healthcare handoffs among lay caregivers

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## Abstract

**Background:** Much of home healthcare is also performed by informal caregivers. This paper seeks to add understanding to the home healthcare field, specifically studying care handoffs between informal caregivers. This study included 16 trained and 20 lay participants to determine differences due to expertise. This comparison is useful because there is a lot of published research on healthcare handoff happenings involving healthcare professionals, and the results indicate how much of the published research can be applied to care handoffs between informal caregivers.

**Objective:** The primary objective of this study is to identify differences between lay and professional caregivers when there is uncertainty in a caregiving handoff from their fellow caregiver.

**Methods:** The study design included between-group analysis of Expertise (layman and expert) and within-group analysis of Task Difficulty and Communication Modality. Dependent variables included willingness to ask for help, confidence in handoff instructions, confidence in the ability to complete tasks and task accuracy. Both Expertise groups were given the same four scenarios in a repeated measures study design.

**Results:** The findings suggest statistically significant differences in how informal caregivers respond to unclear handoff instructions, where lay participants were more confident in understanding instructions, more confident in executing the tasks, less willing to ask for help and also less able to spot and resolve conflicting information compared to trained participants. Lower performance in resolving conflicting information was exhibited by the lay participants. However, when comparing with the syringes that were prepared correctly, it was observed that the accuracy of those prepared syringes was higher for lay participants than for trained participants.

**Conclusion:** It was anticipated that lay participants would be more willing to ask for help due to lack of subject matter expertise and trained participants would be more confident in completing tasks due to their superior subject matter expertise, but the opposite was true in both cases. It was also anticipated that lay and trained participants would be equally confident of the instructions given by their fellow caregiver, yet trained participants were less confident. The results from this study have impacts on the design of instructions (often by formal caregivers) for informal caregivers.

**Key words:** home healthcare, care handoff, informal caregivers

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## Introduction

An informal caregiver is defined as a person who cares for a family member or friend in an unpaid capacity. Informal caregivers often perform what are referred to as activities of daily living such

as bathing, dressing, shopping, cooking or preparing meals. Care will often involve health-related activities meant to manage a health or chronic condition [1]. It is estimated that 48 million Americans provide unpaid care, spending an average of 23.7 hours/week, with

21% of these caregivers reporting more than 41 hours/week spent on caregiving duties [2]. Looking at home healthcare, there are also a substantial number of Americans who receive healthcare in the home from trained professionals.

It is observed that the person performing the work can be either the patient or the caregiver, not just the healthcare professional. Introducing multiple roles highlights the fact that coordination of work is an important part of a sociotechnical analysis for healthcare. One key aspect of this coordination of work is the handoff that occurs between individuals. In traditional healthcare settings, the topic of handoffs has generated much attention due to its high potential for contributing to patient safety issues. A healthcare handoff is defined as an information exchange where an authority for a patient is transferred from one healthcare professional to another [3]. Likewise, in the home setting, a healthcare handoff can be defined as a transfer of authority between informal caregivers for an individual's care. To understand the topic, a literature search was initiated, but relevant published papers that involve informal caregivers were not available; hence, a literature review of handoffs was done across a variety of industries. A broad search revealed 14 papers across three industries (healthcare, manufacturing and aviation) [4–17]. From the literature search, it appears that unlike handoffs between healthcare professionals, handoffs that involve informal caregivers is not a well-researched area. One question that is apparent is 'Is there a difference between professional and informal care givers and if so, which areas and how much?' Thus, a study is needed to understand the influence of different factors on the success of a handoff between informal caregivers.

The primary goal of this study is to identify differences between lay and professional caregivers when there is uncertainty in a caregiving handoff from their fellow caregiver. The hypotheses posited in this endeavor were as follows:

1. There is a difference between the groups in willingness to ask for help. The assumption is that lay caregivers will be more willing to ask for help, based on their lack of subject matter expertise.
2. There is a difference between the groups in two areas, where trained caregivers will perform better due to their subject matter expertise in the completion accuracy for difficult tasks and confidence in completing tasks.
3. There is no difference between the groups for completion accuracy for easy tasks and confidence of the instructions given by their fellow caregiver.

**Table 1** Configuration of independent variables by trial

Trial	Difficulty	Modality	Clarity
Trial 1	Easy	Counterbalanced:	Both ambiguous and conflicting information is present. The order information presented is counterbalanced: <ul style="list-style-type: none"> <li>• 1/2 get ambiguous information presented first in Trial 1, conflicting information presented first in Trial 2</li> <li>• 1/2 get conflicting information presented first in Trial 1, ambiguous information presented first in Trial 2</li> </ul>
Trial 2	Hard	<ul style="list-style-type: none"> <li>• 1/2 get phone for trial 1, chat for trial 2</li> <li>• 1/2 get chat for trial 1, phone for trial 2</li> </ul>	
Trial 3	Easy	Counterbalanced:	Both ambiguous and conflicting information is present. The order information presented is counterbalanced: <ul style="list-style-type: none"> <li>• 1/2 get ambiguous information presented first in Trial 3, conflicting information presented first in Trial 4</li> <li>• 1/2 get conflicting information presented first in Trial 3, ambiguous information presented first in Trial 4</li> </ul>
Trial 4	Hard	<ul style="list-style-type: none"> <li>• 1/2 get phone for trial 3, chat for trial 4</li> <li>• 1/2 get chat for trial 3, phone for trial 4</li> </ul>	

## Methods and procedure

### Participants

Two groups of participants divided by expertise as those with formal healthcare training (trained group) and those without (lay group) were recruited in this study. Formal healthcare training was defined as enrollment in a medical program or experience working in an official medical capacity. For both groups, individuals were excluded if they were minors, had an allergy to colored food dye, hand dexterity limitations, or low understanding of English, determined via intake interviews. The experiment included 16 trained participants (TPs) (15 F/1 M) with mean experience of 10.25 years (SD 12.03) and 20 lay participants (LPs) (18 F/2 M). The average age of the trained group was 33.19 years (SD 13.39) compared with 19.7 years (SD 2.79) for lay group. The participants reported their healthcare experience as Clinical Therapist, Nursing Assistant, Registered Nurse (ICU, Critical Care), Caregiver in Hospice setting and Nurse Practitioner.

### Experimental design

Expertise (lay and trained groups), task difficulty (easy and hard), communication modality (phone call and phone chat) and the order of unclear information (ambiguous information first, conflicting information first) were the four independent variables in this study. All trials included both types of unclear information (here-in called 'clarity') but which type came first in the instructions was alternated to see if participants were sensitive to order. By not having differing levels of Clarity present in the four trials, Clarity was eliminated as an independent variable and clarity order became part of the dependent variable analysis. Ambiguous information was defined as missing information; incomplete information on actions to take or complete, while conflicting information was defined as two or more pieces of information that disagree. In this study, the results are presented to compare the Expertise groups. Both Expertise groups were given the same four scenarios in a repeated measures study design. Counterbalancing was done by creating 16 sets of the four trials, to capture every combination of independent variables (Table 1). Difficulty represented the difficulty level of the trials, represented in the instructions participant received from their fellow caregiver. In each scenario, the participant was working with another caregiver to give care who is not present, so the instructions are handed over asynchronously. Easy difficulty level had tasks where only one type of liquid medication needed to be prepared, so the instructions were relatively simple, while Hard level had tasks where multiple types of liquid medication needed to be prepared, so the instructions had

more detail to read, interpret and act on. The third variable Communication modality at 2 levels (phone and chat) represented the form of communication participants are allowed to use to contact their fellow caregiver (a confederate). For the Phone level, the participant could make simulated phone calls to their fellow caregiver at any point during the execution of the task while Chat meant the participant could send simulated text messages to their fellow caregiver at any point during the execution of the task. A pre-installed Slack mobile app with a dedicated channel on a smart phone was used in this study. Communication sent by participant was monitored by a researcher using a second mobile device, behind the one-way mirror of the testing room.

Twelve dependent variables were considered in this study (Table 2). The instructions for the medication preparation were passed along as an asynchronous handoff from the participant's fellow caregiver. For each scenario, the instructions were intentionally incomplete, in order to prompt participants to reach out to their fellow caregiver for clarification. In order to make these scenarios more realistic, each participant was asked to identify the family

member being cared for, as well as the fellow caregiver he/she was coordinating with to give care.

Participants were asked to use four different blunt-tipped luer-lock syringes (with no needles) of varying sizes (35, 30, 20 and 12 ml). Participants were also provided with bottles, caps and other supplies such as McCormick food coloring mixed with water to simulate liquid medication, eye dropper filled with water, hand-written instructions, and spill prevention supplies.

## Procedure

A simulated home environment was created in the laboratory to encourage naturalistic behavior. All sessions contained four sections: pretrial procedures (familiarization with room and orientation on supply locations), training (consistency in task performance), testing and closing feedback. All tasks involved preparing prefilled doses of liquid medication, so the researcher ensured that participants understood how to read the level of a syringe, as well as how to correctly draw the 'liquid medication' (represented by colored water) into the

**Table 2** Dependent variables

Dependent variables	Unit	Description of measurement
Confidence in understanding of the instructions	Number (Likert scale, 1–7)	How confident the participant is in understanding the instructions from their fellow caregiver, given as part of the survey at the end of each scenario. There is no correct value assigned to this variable.
Explanation of rating	Freeform text	Freeform explanation of rating given for confidence in understanding the instructions from their fellow caregiver, given as part of the survey at the end of each scenario. There is no correct value assigned to this variable.
Confidence in ability to execute the correct steps	Number (Likert scale, 1–7)	How confident the participant is in his/her ability to correctly carry out the task, given as part of the survey at the end of each scenario. There is no correct value assigned to this variable.
Explanation of rating	Freeform text	Freeform explanation of rating given for confidence in ability to carry out task, given as part of the survey at the end of each scenario. There is no correct value assigned to this variable.
Willingness to ask for help	Number	Number of questions asked during the scenario. There is no one correct value assigned to this variable, but participants must ask a minimum of two questions in order to clarify both the ambiguous and conflicting pieces of information present in each scenario.
Ambiguous information clarified?	Binary (yes/no)	Capture whether the participant clarified the piece of ambiguous information. The correct value should be yes for every scenario.
Conflicting information clarified?	Binary (yes/no)	Capture whether the participant clarified the piece of conflicting information. The correct value should be yes for every scenario.
Water color	Color	List the water color that went into the syringe. There is a correct color for each prepared syringe.
Syringe weight	ml	Note the weight of each prefilled syringe prepared by the participant. Each syringe has a correct weight defined.
Supplement drop(s) added properly	Binary (yes/no)	Observe participant during task, to see if the correct number of supplement drops were added to the prefilled syringe. This variable will only be applicable to scenarios 3 and 4, where difficulty level is hard.
Syringe cap color	Color (blue, black)	List the cap color. This variable will only be applicable to scenario 3. There is a correct cap color defined for each prepared syringe.

syringes. The tasks chosen are representative of tasks done by lay and professional caregivers for a variety of conditions but not common outside of healthcare so participants are not likely to have existing experience with them.

Each scenario was first introduced to the participant, outside of the usability lab, as part of simulating the asynchronous handoff given by their fellow caregiver and completed a short survey. In each scenario, the handoff contained one piece of ambiguous information and one piece of conflicting information. Participants should have identified both and reached out to their fellow caregiver to clarify. Participants should then have carried out the tasks as instructed, and each syringe was checked if it contained the correct medication (identified by color) and the correct dosage (measured by weight). After conclusion of all four scenarios, a survey was administered to capture basic participant demographics and invited to provide any closing feedback.

### Data analysis

Depending on the type of data, parametric (including paired t-test, ANOVA) and non-parametric procedures (including Friedman Test, Mann–Whitney U) were employed to compare results between the four scenarios, and within and between each expertise group. Significance level was set at  $\alpha = 0.05$ .

### Results

For both groups, all tasks were fully completed by the participants. Each participant was supposed to prepare 10 syringes; however, in each group, there were instances (7 lay and 20 trained) where the participants failed to make these prefilled syringes. Hence, these data were excluded from the analysis. Table 3 presents summarized results of within-group analyses. Depending on the group, differences were observed in ambiguous piece of information, clarified ambiguous info, confidence of executing the tasks, and the conflicting piece of information.

Table 4 indicates that LPs indicated more confidence in understanding instructions and more confident in their ability to execute tasks while TPs tended to ask more questions for the given scenarios and get more clarifications. A surprising result was obtained for syringe accuracy for which it appears that LPs were more accurate than TPs on average across all trials.

### Trends

Table 5 presents a summary of the group comparisons between scenarios for lay ( $N=20$ ) and trained group ( $N=16$ ). Within the lay group, task difficulty and communication modality did not have a major effect on participants' performance in clarifying ambiguous or conflicting information from the handoff. Instead, there was a statistically significant increase in the number of participants who clarified both the ambiguous and conflicting pieces of information from scenario 1 versus 4.

1. LPs were more confident than trained participants, both in understanding the handoff instructions and executing the requested tasks, yet their performance in clarifying the ambiguous and conflicting information was consistently worse. The gap is especially notable and statistically significant, with conflicting information.
2. LPs were also less likely to ask questions.
3. A significant portion of LPs felt the handoff instructions were clear, even though they were intentionally not. The lay group self-rating was between 3 and 7 ( $M=5.88$ ,  $SD=1.15$ ) while the trained group self-rating was between 1 and 7 ( $M=4.91$ ,  $SD=1.95$ ). For example, one TP group participant rated their confidence as 7, stating 'The instructions were pretty straightforward.' This same participant failed to clarify either the ambiguous or the conflicting pieces of information.
4. LPs were also more likely to make decisions on how to prefill the syringes by relying on their own reason and logic about the missing information, instead of reaching out.

**Table 3** Summary of within-group analysis for the dependent variables

Dependent variable	Test	Result		Comment
		Lay	Trained	
Clarified ambiguous info	Related-samples Cochran's Q test	$P = 0.019$	$P = 0.005$	This result may be a false positive, due to a poor choice of the ambiguous piece of information in scenario 4.
	with Dunn's post hoc tests	Scenario 1 and 4 ( $P = 0.023$ ).	Scenarios 1 and 4 ( $P = 0.021$ ); scenarios 2 and 4 ( $P = 0.021$ ); scenarios 3 and 4 ( $P = 0.021$ ).	
Clarified conflicting info	Related-samples Cochran's Q test	$P = 0.013$	$P = 0.297$	
	With Dunn's post hoc tests	Scenario 1 and 4 ( $P = 0.011$ )		
Confidence in understanding the instructions	Friedman test	$P = 0.974$	$P = 0.954$	
Confidence of executing the tasks	Friedman test	$P = 0.511$	$P = 0.041$	Higher to lower level of confidence in execution of scenarios: 1, 4, 2 and 3
Number of questions asked	One-way repeated measures ANOVA	$P = 0.190$	$P = 0.428$	

*p* values in bold indicates significance.

**Table 4** Summary of between-group analysis for the dependent variables

Dependent variable	Test	Result	Comment
Confidence in understanding instructions	Mann–Whitney U	<i>P</i> = 0.004	Lay participants more confident in their level of understanding of the instructions from their fellow caregiver.
Confidence in executing tasks		<i>P</i> = 0.018	Lay participants were more confident in their ability to execute the task.
Number of questions asked	Two-way between-groups ANOVA	<i>P</i> = 0.029 for group <i>P</i> = 0.172 for scenario <i>P</i> = 0.983 for interaction	Trained participants tended to ask more questions in the four scenarios. The differences between scenarios were not statistically significant, nor does difficulty or communication modality has an impact on the results.
Clarifying ambiguous info	Chi-square test for independence (with Yates Continuity Correction)	<i>P</i> = 0.398	
Clarifying conflicting info		<i>P</i> = 0.010	70.3% of trained participants clarified the conflicting piece of information, compared to 47.5% of lay participants
Syringe accuracy (all scenarios) <sup>a</sup>	Independent-samples t-test	All scenarios: <i>P</i> = 0.014 Easy scenarios: <i>P</i> = 0.055 Difficult scenarios: <i>P</i> = 0.081	No difference in syringe accuracy was found when comparing easy trials between lay and trained groups, or when comparing hard trials between lay and trained groups. <i>However, lay participants were more accurate than trained participants on average across all trials.</i>

*p* values in bold indicates significance.

<sup>a</sup>Syringe accuracy is measured by the delta of prepared syringe weight from expected weight.

**Table 5** Comparisons between scenarios

Dependent variable	Group	Scenario 1	Scenario 2	Scenario 3	Scenario 4	All scenarios
Clarified ambiguous information	Lay	11 (55%)	8 (40%)	10 (50%)	3 (15%)	32 (40%)
	Trained	10 (62.5%)	10 (62.5%)	10 (62.5%)	1 (6.25%)	31 (48.4%)
Clarified conflicting information	Lay	15 (75%)	8 (40%)	8 (40%)	6 (30%)	38 (47.5%)
	Trained	14 (87.5%)	10 (62.5%)	10 (62.5%)	11 (68.8%)	45 (70.3%)
Average rating for confidence of understanding instructions (range: 1–7)	Lay	5.85	5.9	5.85	5.9	5.08
	Trained	4.56	5	4.94	5.13	4.91
Average rating for confidence of executing tasks (range: 1–7)	Lay	5.85	6.15	6.2	6.05	6.06
	Trained	5.88	5.31	4.88	5.31	5.34

- Among TPs, a notable trend was more of an inclination to challenge and question the handoff instructions by their fellow caregiver.
- Tps' expected set of prefilled syringes deviated more from the expected results due to their mistrust of information. Another byproduct of not clarifying the unclear instructions is preparing extra, unnecessary medications. This poses a serious risk, since it could lead to an overdosing of patients.

## Discussion

### Statement of principal findings

There were three main hypothesis evaluated in this study, and the data show that some were accepted and some were rejected. Specifically, we failed to reject the hypothesis that there was no difference between the two groups. In fact, it was found that TPs were more willing to ask for help than LPs. The second hypothesis is that there is a difference between lay caregivers and trained caregivers in

two areas, where trained caregivers will perform better due to their subject matter expertise in the completion accuracy for Difficult Tasks, i.e. making the correct prepared syringes, and confidence in completing tasks yielded two results. The first result for Completion accuracy for Difficult Tasks indicated no difference between the groups but it was inferred that LPs were more confident than TPs in completing their tasks. Finally, it was also found that LPs were more confident than TPs while we failed to reject that there was no difference between lay and trained caregivers for completion accuracy for Easy Tasks.

### Strengths and limitations

The design provides a template for how to set up a simulation of a care-giving handoff in a controlled manner; however, modification could be made for ambiguous information in scenario 4.

### Interpretation within the context of the wider literature

There was a statistically significant difference in willingness to ask for help, measured by number of questions each participant asked their fellow caregiver. Recall, all scenarios were designed so a minimum of two questions were necessary to clarify the instructions. The results demonstrate that training received by medical professionals is beneficial in setting them up to have a successful handoff. As mentioned above, the difference in mindset between the groups should be noted in the lay caregiver handoff education. When participants from the trained group reached out to their fellow caregiver, they took an authoritative, skeptical stance and talked to them more like a subordinate, and the dialog was often a mixture of questions and statement. When participants from the lay group reached out, they tended to talk to them more like a trusted peer.

In terms of questions asked per scenario, LPs tended to reach out more in scenario 1 compared to the other scenarios to clarify conflicting and ambiguous information. In scenario 1, the conflicting information is that the instructions specify using the blue-colored Metformin, yet the blue bottle has no label and there is a yellow bottle labeled Metformin. The ambiguous information is the presence of two prefilled syringes left behind by their fellow caregiver, with no mention of whether they should or should not be used. The performance data by LPs demonstrates that when the conflicting and ambiguous information is blatantly obvious, training or education is less necessary to catch it. At the same time, it should be noted that in the lay group 55% clarified the ambiguous information and 75% clarified the conflicting information for scenario 1, which still leave a lot of room for improvement. In the other scenarios, less than 50% of conflicting and ambiguous information was clarified by LPs.

A closer look at the trained group's performance shows that although their training probably prompted them to reach out more to their fellow caregiver, the rate of clarifying conflicting information is higher than the rate of clarifying ambiguous information (70.3% versus 48.4%). This difference demonstrates that even with healthcare training, more techniques are needed to help spot ambiguous information in the context of a handoff.

Recall that there was no statistically significant difference within the groups regarding confidence in completing tasks, based on task difficulty. However, analysis of confidence between groups, regardless of task difficulty, showed a higher level of confidence among LPs. For confidence in instructions given by their fellow caregiver, there was a statistically significant difference between the groups.

The lay group was more confident, which did not reflect in the performance. Perhaps the higher confidence among LPs was a factor in their lower number of questions. For syringe accuracy in easy and hard tasks, there was no statistically significant difference between the groups. However, LPs ( $M$  0.17,  $SD$  0.22;  $t$  (144) = 2.48,  $P$  = 0.014, two-tailed) in general tended to be more accurate than TPs ( $M$  0.46,  $SD$  1.37). This was counter to the hypothesis that TPs would be more accurate in preparing syringes. They demonstrate that lay caregivers are more likely to not notice incomplete hand-off instructions, feel overly confident and be less willing to ask for help. These ultimately meant an increased likelihood in the wrong set of medications is prepared. It is not a surprise that there would be a greater chance of error when lay caregivers prepare medication, but this increase in potential harm can now be broken down into concrete root causes. These root causes can be addressed through education and coaching by natural interactions with care providers. The key will be for care providers to find out from patients if they have informal caregivers, so they can reach out to them. The impacts of relationship (within the handoff parties) and expertise were found to be influencing factors in the literature review and manifested in this study as a difference of mindset between TPs and LPs.

### Implications for policy, practice and research

As stated above, when LPs did reach out to their fellow caregiver, they were more likely to treat them as peers to be trusted. TPs were more likely to treat their fellow caregivers with more suspicion and more like a subordinate. Care providers should keep this in mind when providing education and coaching, so that the message is not as simple as saying 'pay more attention'. The results from this study have impacts on the design of instructions for informal caregivers. This group could also include minors, marginalized communities, communities with low health literacy and developmentally disabled communities.

### Conclusions

This exploratory research yielded several interesting and surprising results. It was anticipated that LPs would be more willing to ask for help due to lack of subject matter expertise, and TPs would be more confident in completing tasks due to their superior expertise, but the opposite was true in both cases. It was also anticipated that both participants would be equally confident of the instructions given by their fellow caregiver, yet TPs were less confident. This study established that Task Difficulty and Communication Modality did not have a statistically significant impact in medication preparing tasks; however, future research should re-evaluate how task accuracy is measured. Future research could also explore handoffs for other types of caregiving tasks, to see if similar results are found in those areas. The focus can be on caregiving tasks that carry a potential risk/harm to the person receiving care, such as operating a medical device, or even something subtler like properly identifying when a chronic heart failure patient needs an intervention.

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## Contributorship

J.C. collected the data. All authors were involved in the analysis and writing the manuscript. All authors have approved the final version of the manuscript.

## Ethics and other permissions

This study was approved by the university HSIRB (protocol # S17156).

## Data sharing statement

Data available on request.

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