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# Searching for the missing pieces between the hospital and primary care: mapping the patient process during care transitions

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## ABSTRACT

**Background:** Safe patient transitions depend on effective communication and a functioning care coordination process. Evidence suggests that primary care physicians are not satisfied with communication at transition points between inpatient and ambulatory care, and that communication often is not provided in a timely manner, omits essential information, or contains ambiguities that put patients at risk.

**Objective:** Our aim was to demonstrate how process mapping can illustrate current handover practices between ambulatory and inpatient care settings, identify existing barriers and facilitators to effective transitions of care, and highlight potential areas for quality improvement.

**Methods:** We conducted focus group interviews to facilitate a process mapping exercise with clinical teams in six academic health centres in the USA, Poland, Sweden, Italy, Spain and the Netherlands.

**Findings:** At a high level, the process of patient admission to the hospital through the emergency department, inpatient care, and discharge back in the community were comparable across sites. In addition, the process maps highlighted similar barriers to providing information to primary care physicians, inaccurate or incomplete information on referral and discharge, a lack of time and priority to collaborate with counterpart colleagues, and a lack of feedback to clinicians involved in the handovers.

**Conclusions:** Process mapping is effective in bringing together key stakeholders and makes explicit the mental models that frame their understanding of the clinical process. Exploring the barriers and facilitators to safe and reliable patient transitions highlights opportunities for further improvement work and illustrates ideas for best practices that might be transferrable to other settings.

patient safety as care evolves around the patient, crossing shift changes, care teams and care settings. Care transitions present an increased opportunity for errors that may result in patient harm, and have been recognised as a key cause of preventable morbidity by WHO, The Joint Commission, and the Australian Commission on Quality and Safety in Health Care.<sup>1–3</sup> Organisations have now gone beyond highlighting and describing the problem to recommending and supporting solutions.<sup>4 5</sup>

Primary care physicians (PCPs) are not satisfied with communication at transition points between ambulatory and inpatient care, find that the communication is fraught with content omissions, not performed in a timely fashion, and believe that ineffective communication can lead to real harm.<sup>6</sup> A study of 2003–2004 US Medicare claims data found that almost one-fifth (19.6%) of the 11 855 702 Medicare beneficiaries who had been discharged from a hospital were rehospitalised within 30 days, and of those, more than half of patients who were rehospitalised following discharge to the community did not see their PCP prior to the readmission. Of the patients who were rehospitalised within 30 days after a surgical discharge, 70% were rehospitalised for a medical condition.<sup>7</sup> One way to reduce patient readmissions to the hospital within 30 days of discharge is to ensure appropriate and timely follow-up with their PCP.

A Consensus Policy statement put forth by six societies in the USA (the American College of Physicians, the Society of General Internal Medicine, the Society of Hospital Medicine, the American Geriatrics Society,

Patient care transitions have been identified as a vulnerable point in the care process, and institutions struggle with how best to ensure

the American College of Emergency Physicians, and the Society of Academic Emergency Medicine) to address quality gaps in the transitions between inpatient and outpatient settings acknowledged that future research will need to address a number of challenges: the extent to which electronic health records may provide effective solutions to problematic transitions; use of a transition record with a core dataset; establishing a medical home and the implications of coordination of care across settings; the role of pay for performance structures in rewarding safe, complete transfers of care; equitable care transition standards and measures for all patient populations regardless of socioeconomic status; and a role of patients, patient empowerment and co-participation to ensure better approaches.<sup>8</sup>

In 2007, the Agency for Healthcare Research and Quality in the USA funded the authors to conduct a study to explore a model for effective communication for patient transitions from inpatient to community care settings. In 2008, the European Union FP7 Health Programme commissioned the European HANDOVER study to examine transitions of patient care.<sup>9 10</sup> Academic centres in six European countries—Italy, the Netherlands Poland, UK, Spain and Sweden—participated in this study, with data collection occurring in all countries except the UK. The US and European based research effort used process mapping as the main method to elicit and understand current patterns of care and to highlight opportunities for process improvement.

The aim of this paper is to present process mapping as an effective tool to assess communication patterns during the inpatient to ambulatory transition and to identify barriers and facilitators to effective communication in six academic health centres in the USA and in Europe. We present the similarities and differences between the handover processes used in different nations and settings, and discuss the methodological strengths of process mapping as a generalisable tool for engaging key stakeholders and in redesigning clinical services.

Studies have demonstrated how poor communication processes during handovers contribute to errors and inefficiency of care.<sup>11 12</sup> A core method used to understand the nature and content of work is process mapping, which describes and analyses how an individual clinician interacts with the system itself and with other providers within that system.<sup>13</sup>

A process map or flowchart is a picture of the sequence of steps in a process. Process maps describe what an individual is required to do, in terms of cognitive processes, actions or both to achieve the system's goal. Process mapping can be accomplished through observations, focus groups, and/or individual interviews with key stakeholders that carefully break down the multiple steps in the process.<sup>14</sup> A process map can be used to build an

understanding of current work processes and to identify opportunities for process redesign.<sup>15 16</sup>

Process mapping, used in conjunction with team-based discussion and feedback, enables team members to gain insight into how colleagues perceive the same tasks, and reach a shared understanding of the necessary steps to complete the activities. Process maps have been used in an intervention to standardise resident handovers by identifying gaps and vulnerabilities in the current approach to hand-off communication in physician residency programmes and enhancing resident physician acceptance of the solution.<sup>16</sup> Research on transitions of care has suggested that interventions to sustain improvements in handover outcomes are not sustainable in the absence of explicitly addressing the handover process.<sup>17</sup>

## METHODS

We conducted focus group interviews with key stakeholders associated with patient transitions across the continuum of care settings from community to inpatient care. In the USA, we conducted three focus group interviews with medical teams (ie, hospitalists, internal medicine residents and PCPs) at an urban academic medical centre during 2007–2008.<sup>18</sup> In Europe, we conducted a focus group interview with a multidisciplinary team during 2009 and 2010 in academic health centres in five countries—Italy, the Netherlands, Poland, Spain and Sweden.<sup>9 19</sup> The interviews were used to create a process map underpinning the patient's handover journey from the hospital to the community, and to gain an understanding of the stakeholder perceptions about the barriers and facilitators for an effective transition.

The moderators worked with participants to generate an initial draft of a process map that represented the current process used for communication during ambulatory to inpatient care transitions. Participants were invited to reflect and refine the draft process maps in real time during the focus group interview, and to identify the barriers and facilitators related to each step of the process. Following the focus group, one of the moderators created the final version of the process maps using Microsoft Visio.

The focus group interviews were scheduled for 1 h and were audiotaped and transcribed for analysis. Ethics approval was granted from each participating academic health centre.

## RESULTS

The process mapping exercise confirmed that there were several barriers and facilitators to communication between inpatient care teams. At a high level, the process of patient admission to the hospital through the emergency

department (ED), inpatient care and discharge back in the community was comparable across the study, yet there were also unique aspects about the patient's journey at each of the sites. Process mapping provided an opportunity to engage the key stakeholders in an explicit conversation about what actually occurs (versus what they would like to occur) during various steps in the patient journey. Identifying the barriers and facilitators highlighted best practices (what they would like to make sure continues to occur and might be worthwhile translating to other settings) and opportunities for improvement. **Figures 1–6** provide a high-level overview of patient care processes from hospital admission to discharge across the six study sites.

**Figure 1** illustrates the process map of the internal medicine residents at the University of Chicago, Illinois and delineates the clinical process from the time the patient presents to the ED to the resident's decision to contact the PCP about the patient's discharge. Barriers to contacting the PCP included identification of the PCP, which hinged on the availability of PCP contact information, not knowing the PCP's communication preferences, prioritisation of PCP contact (the importance to the patient vs fear of losing control of the care process once the PCP starts to make suggestions) and forgetting or being too busy to contact the PCP.

**Figure 2** highlights the care process from Azienda Sanitaria in Florence, Italy. The process map demonstrates that, similar to processes at the University of Chicago, when electronic resources are not fully integrated across care settings, this creates barriers to contact with the patient's PCP. Of particular note, a facilitator unique to Azienda Sanitaria was the use of a dedicated hospital physician who is in charge of giving information to the ED and the PCP, and the use of 'fast tracking' diagnostic tests during the referral from the general practitioner to expedite care in the ED.

**Figure 3** shows the care process as mapped by the Dutch team of researchers from Radboud Nijmegen University Medical Centre and the University Medical Centre Utrecht. The Dutch focus groups highlighted the facilitative role of the family/carers in the patient journey to provide accurate and relevant information, such as the patient's actual medication upon admission. Lack of knowledge about the role of home nursing was identified as an important barrier to effective communication. The Dutch process map underscores the presence of a transfer/liason nurse as an important coordinator of care at discharge. However, handover via a transfer/liason nurse also means less direct communication lines between hospital and community care providers. Electronic resources are considered to be an important facilitator for timely information exchange. Electronic resources need to be fully integrated across settings, and they need to contain information that is

accurate, complete, accessible and up to date. Another barrier identified in the Dutch process map, similar to the situation at the University of Chicago and Azienda Sanitaria, are the perceptions of professionals regarding the need to collaborate with colleagues in other care settings and the way care needs to be continued after referral or discharge. For example, there are differences in opinion between hospital nurses and home nurses about the best treatment for wound care.

The process map from Poland's National Centre for Quality Assessment in Healthcare is shown in **figure 4**. In Poland, patients play an important role as the carrier of information about their own illness—and this was identified as a barrier and a facilitator to effective handovers. When patients were too sick to perform this role, or lacked a family member to serve as an information conduit, this created a barrier to effective patient care. The lack of accurate patient information at admission, such as updated medication lists, posed a challenge for hospital-based clinician efforts.

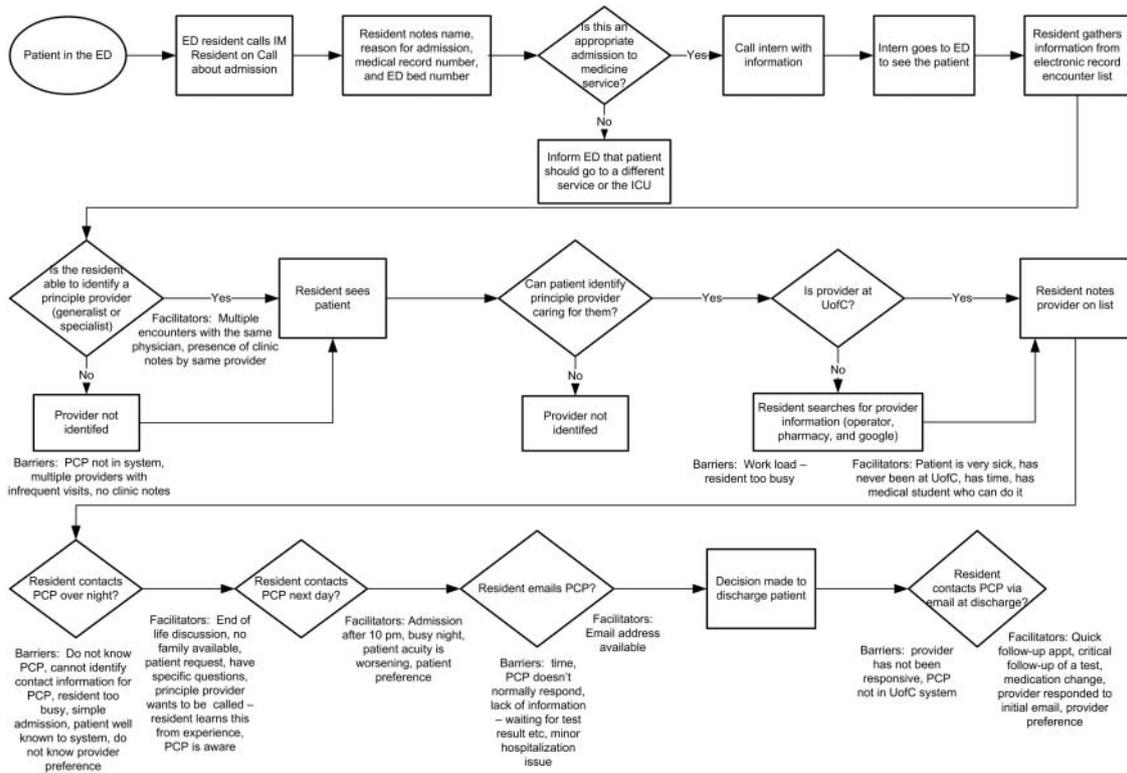
The process map from the Avedis Donabedian Institute, Autonomous University of Barcelona, Spain (**figure 5**) shows that if a patient meets specific inclusion criteria, discharge communication was facilitated by a clinical programme designed to improve continuity of care (PREALT). This included scheduling a home visit within 24–48 h after discharge and a visit with the PCP within 5 days. While this could be considered best practice, it was also identified as a barrier because the existence of these programmes was not known to all healthcare professionals, and not all patients met the inclusion criteria.

At the Karolinska Institute in Stockholm, Sweden (see **figure 6**) setting expectations for discharge with the family/care givers occurred early during the hospitalisation, and was viewed as an effective way to identify community resources to support the patient. A major barrier to communication in Sweden (similar to the processes mapped in **figures 1** and **2**) was the inability to accurately identify the PCP. The Karolinska Institute also identified problems with the availability of interpreters as a barrier in their setting.

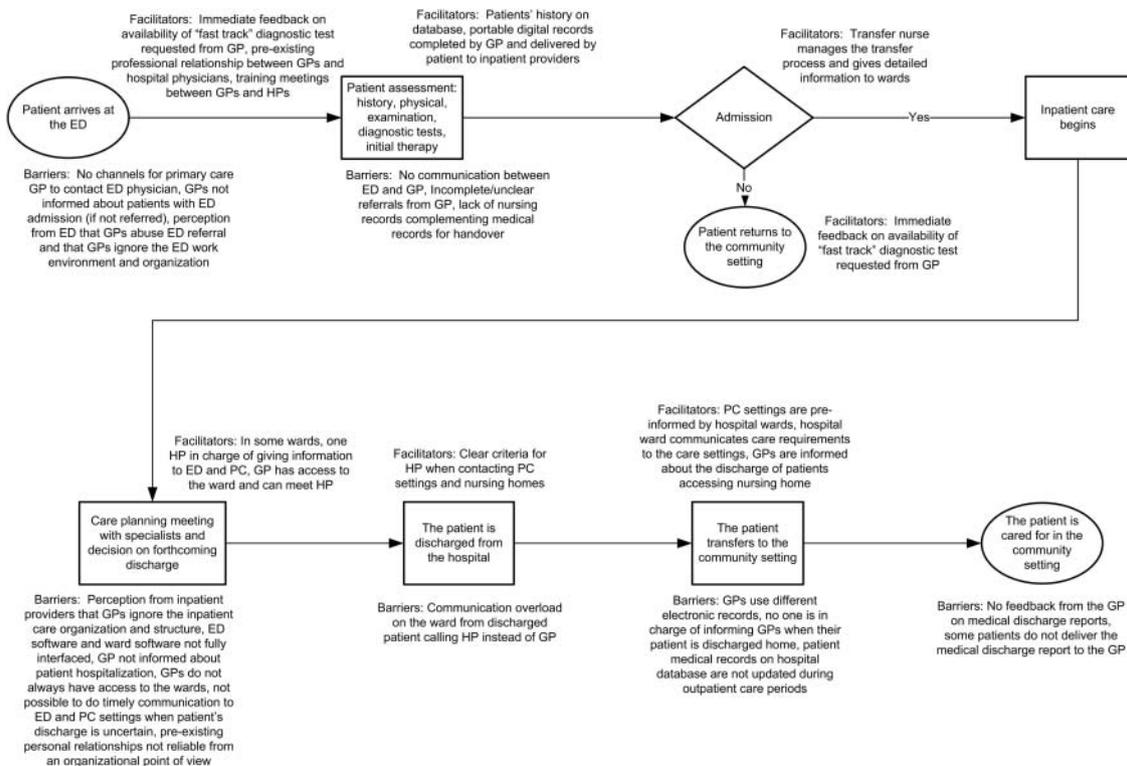
Across all six settings, the mapping exercise identified an improvement opportunity by building in a feedback loop to identify what went well and what could be improved during the handovers.

## DISCUSSION

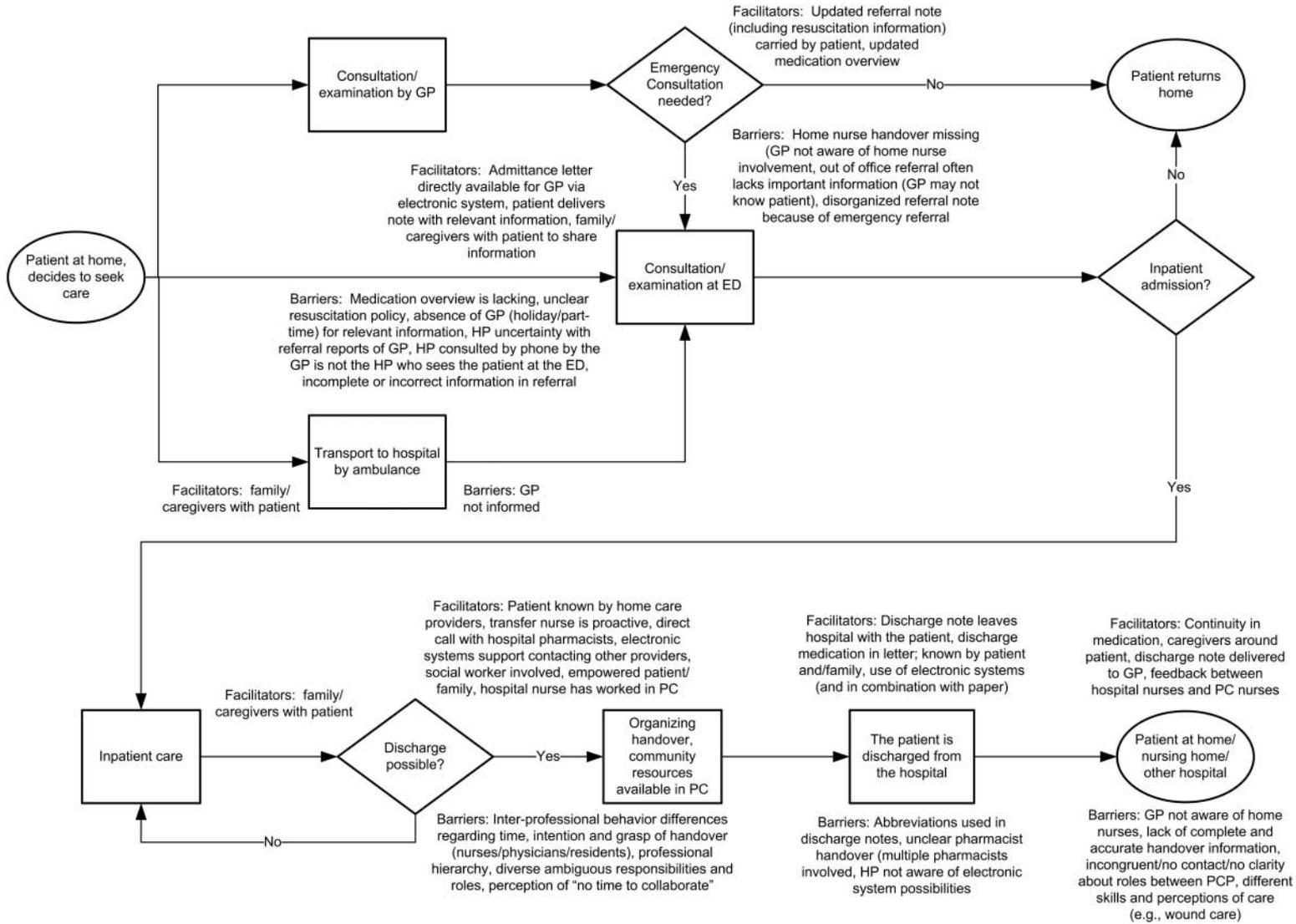
Understanding the process of clinical care has major implications for clinicians' ability to improve patient care. The approach for creating the process map is important because it has implications for engaging clinicians and supporting implementation of changes in



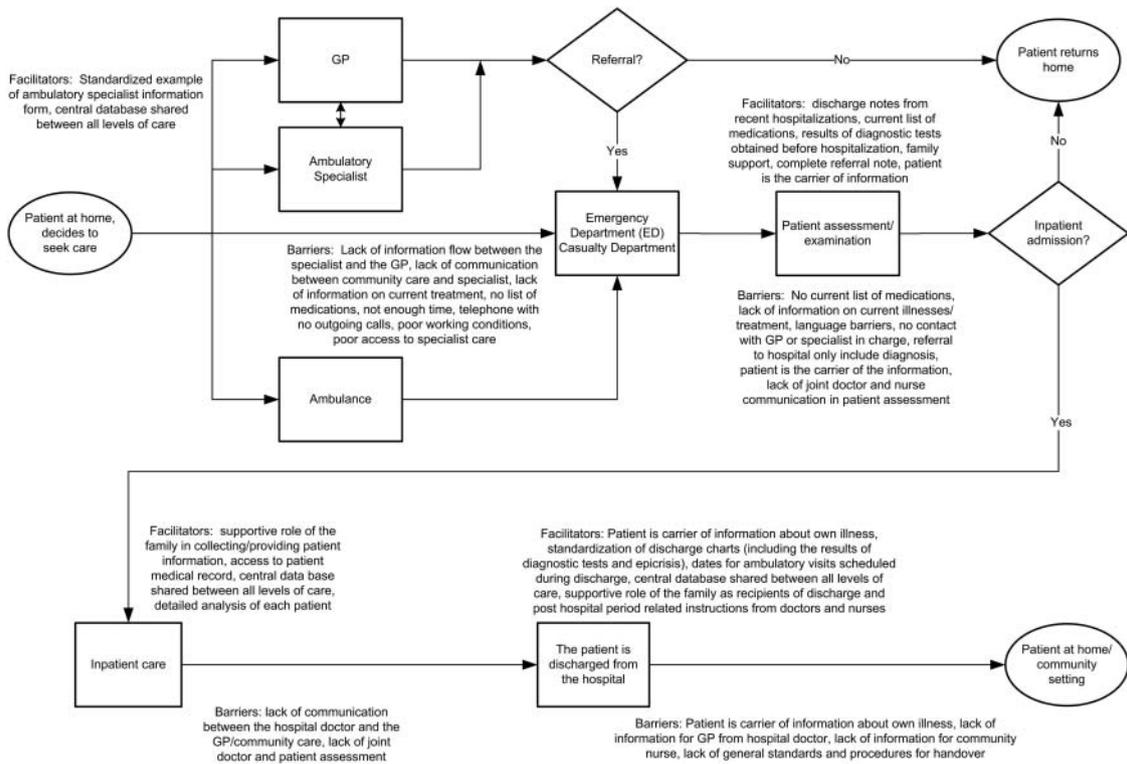
**Figure 1** University of Chicago, USA. Process for patient admission to the emergency department (ED), subsequent inpatient admission, and discharge to the community. ICU, intensive care unit; IM, internal medicine; PCP, primary care physician; UoC, University of Chicago.



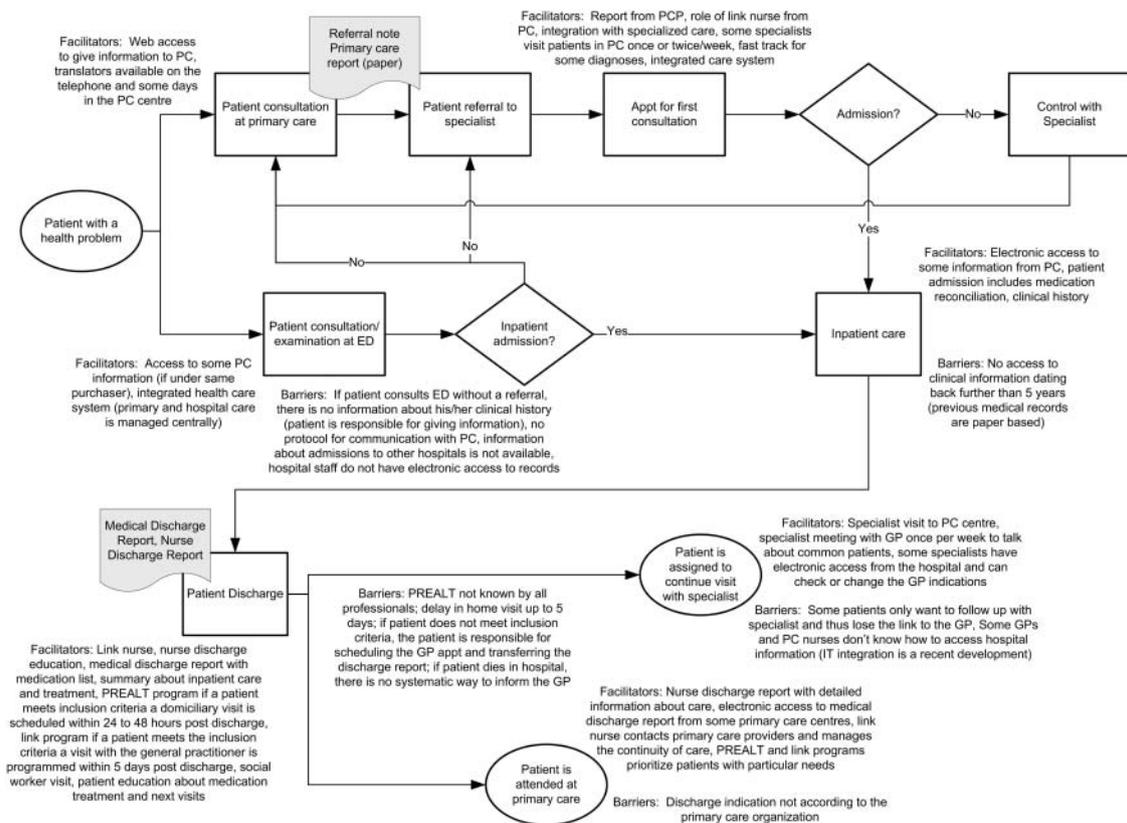
**Figure 2** Azienda Sanitaria Firenze, Italy. Process for patient admission to the emergency department (ED), subsequent inpatient admission, and discharge to the community. GP, general practitioner; HP, health professional; PC, primary care.



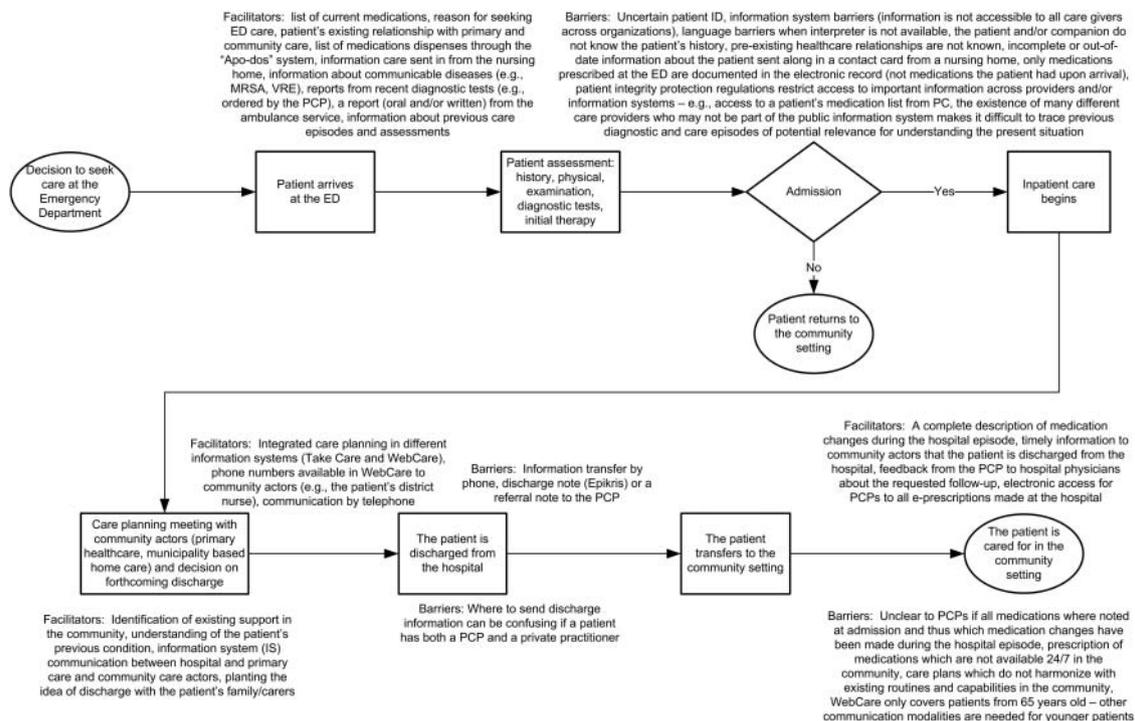
**Figure 3** Radboud Nijmegen University Medical Centre and the University Medical Centre Utrecht, The Netherlands. Process for patient admission to the emergency department (ED), subsequent inpatient admission, and discharge to the community. GP, general practitioner; HP, health professional; PC, primary care.



**Figure 4** National Centre for Quality Assessment in Healthcare, Poland. Process for patient admission to the emergency department (ED), subsequent inpatient admission, and discharge to the community. GP, general practitioner.



**Figure 5** Avedis Donabedian Institute, Autonomous University of Barcelona, Spain. Process for patient admission to the emergency department (ED), subsequent inpatient admission, and discharge to the community. GP, general practitioner; PC, primary care; PCP, primary care physician.



**Figure 6** Karolinska Institute, Sweden. Process for patient admission to the emergency department (ED), subsequent inpatient admission, and discharge to the community. MRSA, methicillin resistant *Staphylococcus aureus*; PC, primary care; PCP, primary care physician; VRE, vancomycin-resistant enterococci.

care. Imagine two scenarios. The first scenario involves a researcher observing ward rounds and carefully documenting the steps in the process which is later reported back to the clinical team. The second scenario involves sitting with the clinical team to discuss the process they use for conducting ward rounds and constructing the process map as they recall the actual steps in the process. Facilitating the creation of the process map with the key stakeholders is a powerful way to engage clinicians by capturing the process from the users' perspective, including their language and interpretation of events. The strength of this approach lies in bringing the stakeholders together to reflect on their work and agree on what is involved in the actual process.<sup>20</sup> As a result, stakeholders start to become 'process literate' and become more aware of the complex underpinnings of their patients' journey of care. Klein and others call this enhanced situational awareness. They describe a gap in the relationship between knowledge of work in the world versus the knowledge of work that is carried around in the head.<sup>21</sup> Process mapping bridges the gap.

Ericsson and Simon argue that the closest connection between thinking and verbal reports is found when subjects verbalise their thoughts generated during task completion in a 'talk aloud protocol'.<sup>22</sup> Process mapping provides a similar opportunity to get a glimpse of how expert clinicians approach and problem solve, and offers a venue for participants to be explicit about their

work while bouncing it off other clinicians as they strive to make sense of their work. These sense-making tools help clinicians understand the complex nature of modern care and help to reduce the chances of key patient care processes to fail.<sup>23</sup> Other methods could be used to describe the process—for example, real-time ethnographic observation of handovers.<sup>24 25</sup> The value of a process mapping exercise is that it clarifies the process for the people who do the work and builds bridges to engage these clinicians in future improvement work.

A seamless transition from inpatient care to outpatient care relies on accurate communication between all professionals and other care givers involved in the patient's care. However, too often the transitions from the hospital to the ambulatory setting include errors and omissions, in part due to the complexity and volume of the interventions performed in the inpatient setting. PCPs described an ineffective and fragmented process in which they often were not notified regarding a patient admission and found out about it after the fact. In these instances, PCPs waste precious time trying to 'piece together' what happened based on incomplete data. Research has found that PCPs are often not aware of tests that require follow-up upon hospital discharge.<sup>26</sup> Effective communication may prevent gaps in clinical knowledge that may occur at these transition points. The challenge is learning how to improve transitions of

patient care in a more systematic way by proactively planning and redesigning care processes to reduce vulnerabilities.

One limitation of our study is that, while we used process maps to describe handovers in six different settings, we did not use the maps to design improvements. Another limitation is the question of generalisability of the process maps and the barriers and facilitators to communication between inpatient clinicians and primary care clinicians. The six sites included in the study are not necessarily representative of the patient journey in other hospitals in these countries.

## CONCLUSIONS

Process knowledge is at the core of any improvement work,<sup>27</sup> and process mapping is a powerful tool for bringing together key stakeholders and making explicit the mental models that frame each stakeholder's understanding of a clinical process. The findings from the six study sites confirm that communication between hospital physicians and PCPs is fraught with ambiguous information. Barriers and critical decision steps in the communication process are often influenced by the presence of barriers or facilitators to the process. The maps highlight opportunities for improving inpatient care to community communication and coordination of patient transitions.

The advantages of using process mapping to explore inpatient to ambulatory transitions include the ability to explore, clarify and challenge multiple stakeholder views about the workflow and the roles that each stakeholder plays in ensuring continuity during the inpatient to ambulatory journey. This sheds light on divergent cultures, policies and practices of the inpatient and outpatient settings and how to bridge and improve communication at their interface. Ultimately, improving patient outcomes requires appreciating the inherent link between process and result, and identifying the potential areas for improvement that do not focus on the individual, but instead, focus on the system that is producing the processes and outcomes of care.<sup>27</sup> Visualising the process helped identify inefficiencies (ie, parallel or redundant processes) and clarify role ambiguity among team members, which impede the provision of coordinated patient care. The problems (and potential solutions) become clearer once the process is made explicit.

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**Contributors** Study conception and design: JKJ, JF, VA, PB. Acquisition of data: JKJ, JF, VA, PB, LP, GH, HW. Data analysis and interpretation: JKJ, JF, VA, PB, LP, GH, HW, CK. Drafting and/or revising the article: JKJ, JF, VA, PB, LP, GH, HW, CK.

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**Data sharing statement** Data and tools are available upon request from the corresponding author.

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## REFERENCES

1. World Health Organization. *Patient Safety: Action on Patient Safety: High 5s*. 2007. <http://www.who.int/patientsafety/implementation/solutions/high5s/en/index.html> (accessed 11 Oct 2012).
2. The Joint Commission Center for Transforming Healthcare. Hand-off communications. 2012. <http://www.centerfortransforminghealthcare.org/projects/detail.aspx?Project=1> (accessed 24 Oct 2012).
3. Australian Commission on Safety and Quality in Health Care. *Safety and Quality Improvement Guide Standard 6: Clinical Handover (October 2012)*. Sydney. ACSQHC, 2012.
4. Arora V, Manjarrez E, Dressler D, *et al*. Hospitalist handoffs: a systematic review and task force recommendations. *J Hosp Med* 2009;4:433–40.
5. Snow V, Beck D, Budnitz T, *et al*. Transitions of Care Consensus Policy Statement American College of Physicians-Society of General Internal Medicine-Society of Hospital Medicine-American Geriatrics Society-American College of Emergency Physicians-Society of Academic Emergency Medicine. *J Gen Intern Med* 2009;24:971–6.
6. Kripalani S, LeFevre F, Phillips CO, *et al*. Deficits in communication and information transfer between hospital-based and primary care physicians: implications for patient safety and continuity of care. *JAMA* 2007;297:831–41.
7. Jencks SF, Williams MV, Coleman EA. Rehospitalizations among patients in the Medicare fee-for-service program. *N Engl J Med* 2009;360:1418–28.
8. Snow V, Beck D, Budnitz T, *et al*. Transitions of Care Consensus policy statement: American College of Physicians, Society of General Internal Medicine, Society of Hospital Medicine, American Geriatrics Society, American College of Emergency Physicians, and Society for Academic Emergency Medicine. *J Hosp Med* 2009;4:364–70.
9. The European HANDOVER Research Collaborative. *Handover*. 2009. <http://www.handover.eu/index.html> (accessed 24 Oct 2012).
10. Barach P, Gademan P, Kalkman C, *et al*. *Identify Basic Elements of Effective Communication*. Utrecht, The Netherlands: The European HANDOVER Research Collaborative, 2010.

11. Pezzolesi C, Schifano F, Pickles J, *et al*. Clinical handover incident reporting in one UK general hospital. *Int J Qual Health Care* 2010;22:396–401.
12. Horwitz LI, Moin T, Krumholz HM, *et al*. Consequences of inadequate sign-out for patient care. *Arch Intern Med* 2008;168:1755–60.
13. Trebble TM, Hansi N, Hydes T, *et al*. Process mapping the patient journey: an introduction. *BMJ* 2010;341:c4078.
14. Barach P, Johnson J. Understanding the complexity of redesigning care around the clinical microsystem. *Qual Saf Health Care* 2006;15(Suppl 1):i10–6.
15. Barach P, Johnson J. Safety by design: understanding the dynamic complexity of redesigning care around the clinical microsystem. *Qual Saf Health Care* 2006;15(Suppl 1):i10–16.
16. Arora V, Johnson J. A model for building a standardized hand-off protocol. *Jt Comm J Qual Patient Saf* 2006;32:646–55.
17. Van Eaton E. Handoff improvement: we need to understand what we are trying to fix. *Jt Comm J Qual Saf* 2010;36:51–1.
18. Arora VM, Prochaska ML, Faman JM, *et al*. Problems after discharge and understanding of communication with their primary care physicians among hospitalized seniors: a mixed methods study. *J Hosp Med* 2010;5:385–91.
19. Lilford R, Chilton P, Hemming K, *et al*. *Report on the Likely Cost of the Various Prototype Interventions Based on a Model of the Likely Costs*. Utrecht, The Netherlands: The European HANDOVER Research Collaborative, 2010.
20. Cassin BR, Barach PR. Making sense of root cause analysis investigations of surgery-related adverse events. *Surg Clin North Am* 2012;92:101–15.
21. Norman D. *The Design of Everyday Things*. New York: Basic Books, 1988.
22. Ericsson K, Simon H. *Protocol Analysis: Verbal Reports as Data*. Cambridge, MA: MIT Press, 1993.
23. Weick KE. The collapse of sensemaking in organizations: the Mann Gulch disaster. *Adm Sci Q* 1993;38:628–52.
24. Patterson ES, Roth EM, Woods DD, *et al*. Handoff strategies in settings with high consequences for failure: lessons for health care operations. *Int J Qual Health Care* 2004;16:125–32.
25. Carroll JS, Williams M, Gallivan TM. The ins and outs of change of shift handoffs between nurses: a communication challenge. *BMJ Qual Saf* 2012;21:586–93.
26. Roy CL, Poon EG, Karson AS, *et al*. Patient safety concerns arising from test results that return after hospital discharge. *Ann Intern Med* 2005;143:121–8.
27. Deming WE. *The New Economics for Industry, Government, Education*. Cambridge, MA: Massachusetts Institute of Technology Center for Advanced Engineering Study, 1993.