

Paper Review #9

[CSCW 2021] Patterns of Patient and Caregiver
Mutual Support Connections in an Online Health Community

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2. Method

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1. Introduction

Research Questions

RQ1 (Initiations) :

What factors are associated with the initiation of a new connection by an author?

RQ1a :

Which authors initiate peer connections?

RQ1b :

When do authors initiate peer connections?

RQ1c :

With whom do authors initiate peer connections?

Research Questions (Cont'd)

RQ2 (Relationships) :

What factors are associated with the reciprocation and growth of connections between peer authors?

RQ2a :

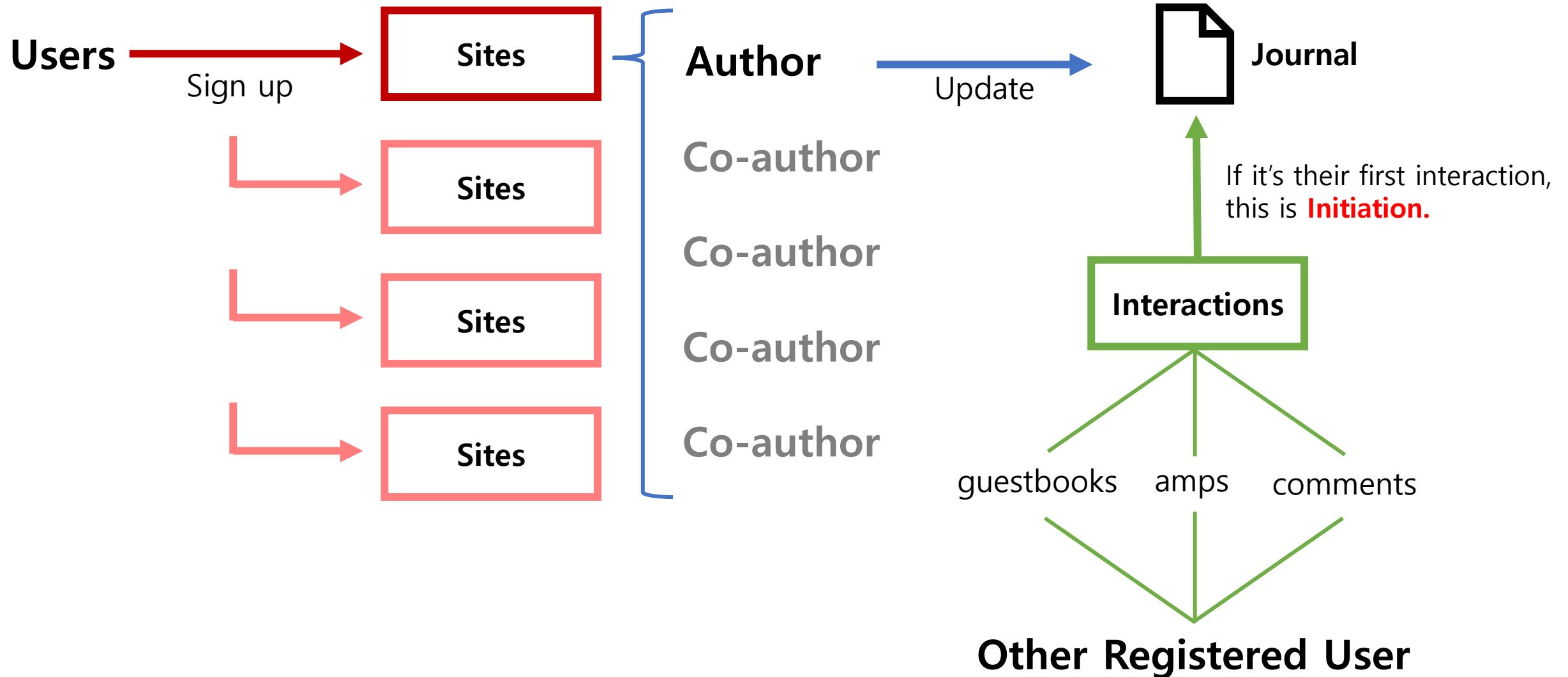
Which authors **reciprocate**? To **which initiators**?

RQ2b :

What factors lead to more **interactive** relationships?

2. Method

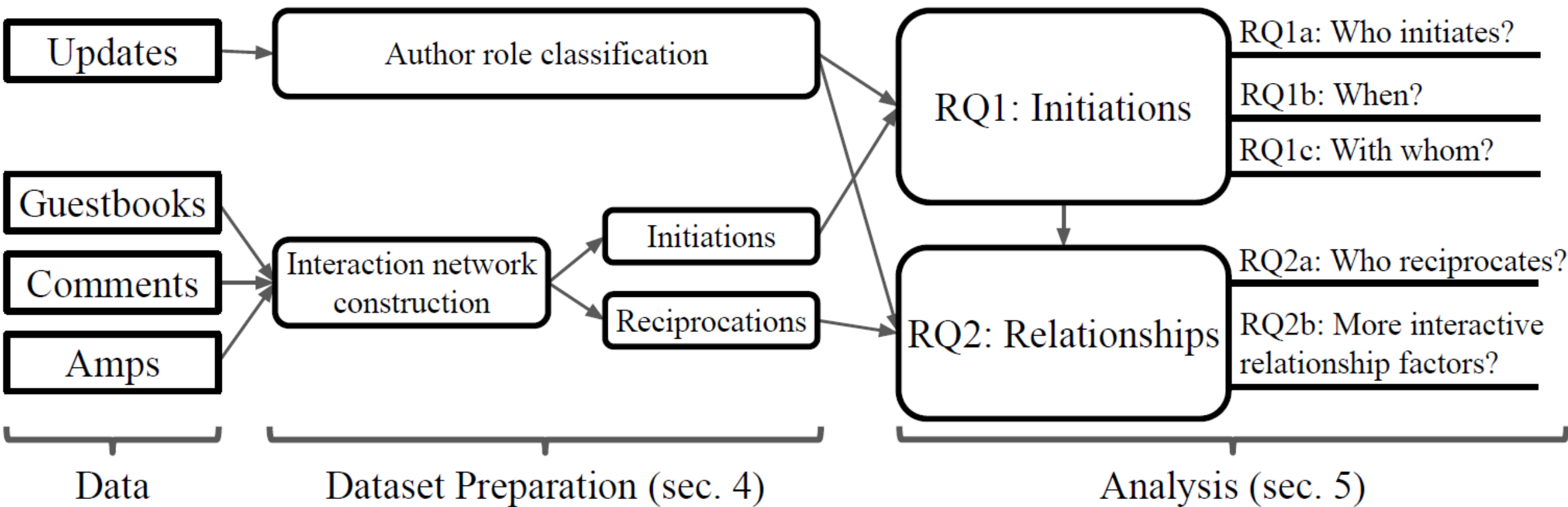
About CaringBridege



Dataset Description

- From **CaringBridge.org**
- **# of authors** : 535,481
- **# of sites** : 588,210
- **# of journal updates** : 19M
- **Observation Period** : June 1, 2005 to June 3, 2016

Dataset Description (Cont'd)



Authorship on CB

A. Valid author selection

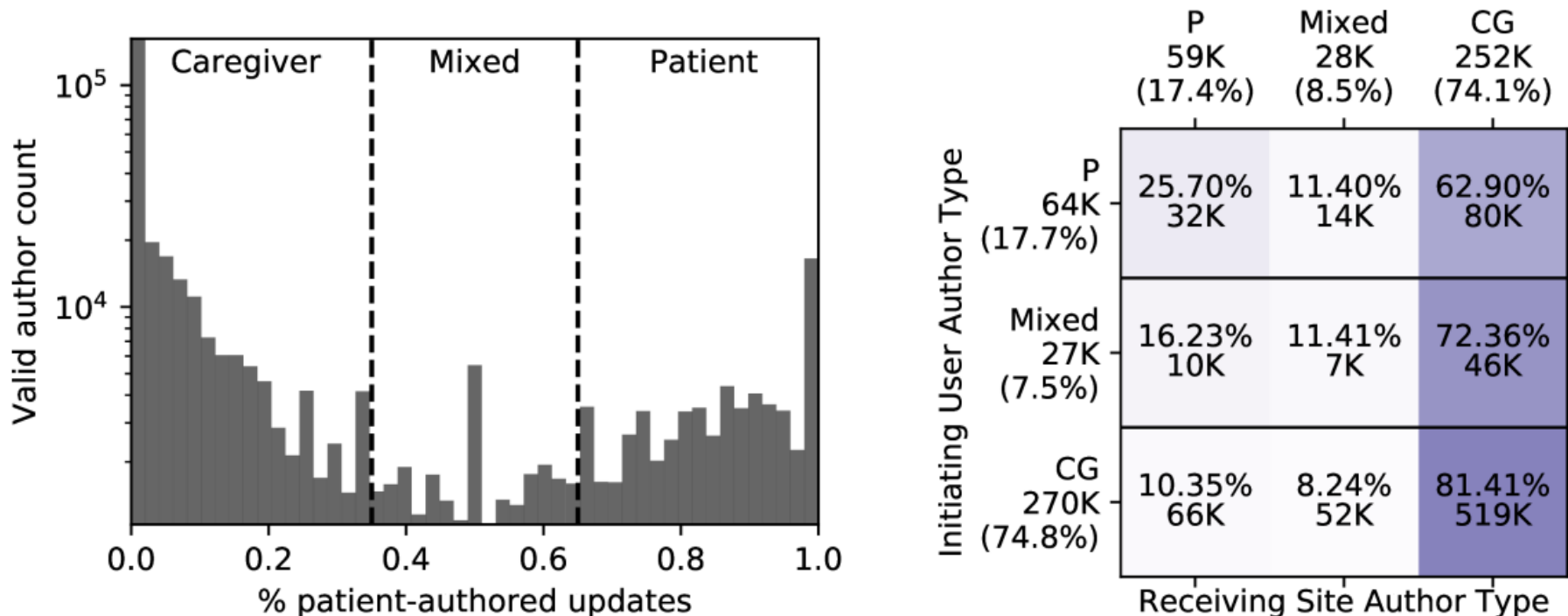
- 362,345 valid user selected.

B. Author role classification

- Use **SVM classifier**. (annotated 429 updates + pre-study's 6,932 updates)
- **Caregiver** : 74.77%, **Patient** : 17.74%, **Mixed** : 7.49%

(accuracy : 95.08%)

Authorship on CB (Cont'd)



(a) Distribution of the proportion of each author's updates that are classified as patient-authored. Vertical lines indicate the thresholds used to assign a role to each author.

(b) Initiation counts broken down by the author role assigned to the initiating author and the receiving site.

Fig. 2. Classification of author role based on the text of an author's updates (a) enables a comparison of author initiations by assigned role (b).

Author Interactions & Network Structure

Interactions in CaringBridge

The screenshot displays the CaringBridge website interface. At the top, there is a navigation bar with links for 'My Account', 'About Us', 'How It Works', 'Start A Site', 'Resources', and a search icon. A 'Donate to CaringBridge' button is also present. The main section is titled 'Journal' and features a 'Sort: Newest to Oldest' dropdown and a 'Print' button. A calendar icon on the left indicates the date 'JAN 1 2020'. The journal entry is titled 'progress update' and is by 'Alex Walker' from 'Jan 1, 2020'. The text of the entry describes a medical update. Below the entry, there are '30 Hearts' and '16 Comments'. A callout '(a) Amp' points to the heart icon. Below the entry is a 'COMMENTS' section. A callout '(b) Comment' points to a comment by 'Jen Wilson' from 'Jan 1, 2020'. At the bottom, there is a 'Guestbook' section. A callout '(c) Guestbook' points to the 'Guestbook' title. The guestbook entry is by 'Jane Smith' from 'Jan 1, 2020' and contains a message of support. The page also includes a 'Sort: Newest to Oldest' dropdown and a 'Print' button for the guestbook.

My Account

CARING BRIDGE

Donate to CaringBridge

About Us How It Works Start A Site Resources Search

Journal

Sort: Newest to Oldest Print

JAN 1 2020

progress update

Journal entry by Alex Walker — Jan 1, 2020

The doctor told me what I thought I would never hear again. My cancer is back.... I have never been so pissed.

I am going to start on chemo first thing tomorrow. After a round I will have a two week break, and then more chemo and then: transplant. They are adding me to the bone marrow registry now to find a perfect match.

(a) Amp

30 Hearts 16 Comments

Patients and caregivers love hearing from you; add a comment to show your support.

COMMENTS

(b) Comment

Jen Wilson | Jan 1, 2020

I don't know you, Alex, but I am friends with Sandi. My husband had 2 transplants. You are in the best of hands! Dr. Campbell knows our family well! Good luck...god bless you!

Reply

(c) Guestbook

Sort: Newest to Oldest Print

Jane Smith | Jan 1, 2020

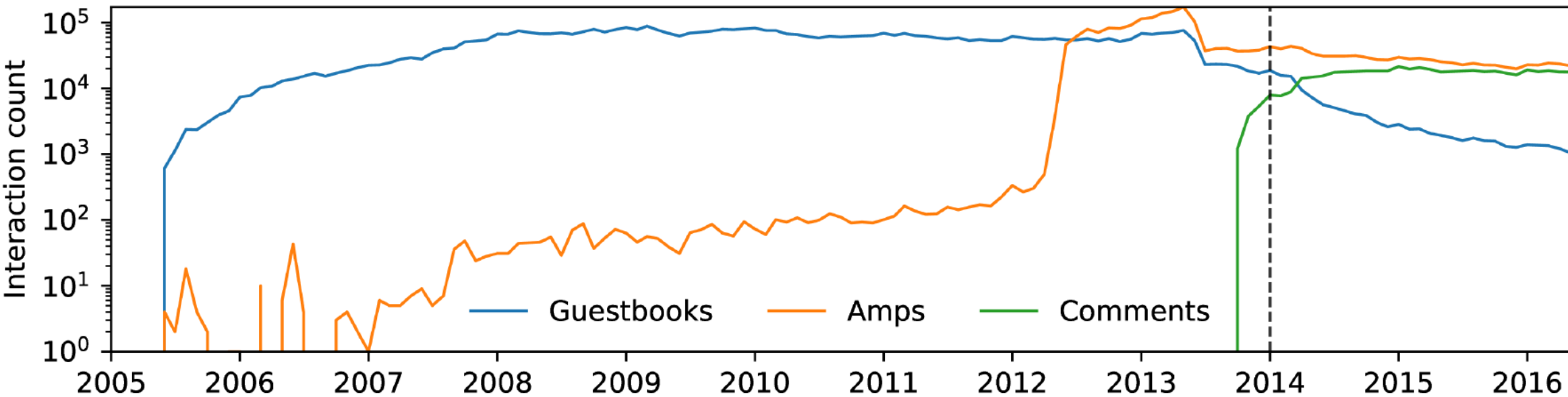
Hi Alex,

My name is Jane, in November my husband Scott was diagnosed with stage 4 colon cancer. Liz Johnson shared your story with me. Prayers are with you and your family!! Scott's caringbridge is under Scott Fischer.

Author Interactions & Network Structure

Interactions in CaringBridge (Cont'd)

	All interactions	From valid authors	Non-self-interactions	Initiations
Guestbooks	82,980,359	5,864,304	5,212,720	654,192
Amps	63,314,738	3,536,819	3,037,844	148,787
Comments	31,052,715	1,094,435	881,781	111,623
Total	177,347,812	10,495,558	9,132,345	914,602



Author Interactions & Network Structure

Interaction Network Structure

- **SCC**(Strongly-Connected Component) : interacted with **each other**.
- **WCC**(Weakly-Connected Component) : interaction has not been **reciprocated**.

Active Authors	66,440	SCC Count	2,590
Connected Authors	55,655 (83.8%)	WCC Count	2,335
Isolates	10,785 (16.2%)	Largest SCC Size	16,946 (25.5%)
Max In-degree	612	Largest WCC Size	45,038 (67.8%)
Max Out-degree	409	Largest SCC Diameter	38

Table 2. Summary statistics for the interactions network at the end of the dataset (2016-06-01).

- **Indegree & Outdegree** are **positively correlated**. ($r=0.468$)

RQ1 (*Initiations*) Method

Factors associated with the initiation

- Network features
- Author role features
- Activity features
- Health condition features

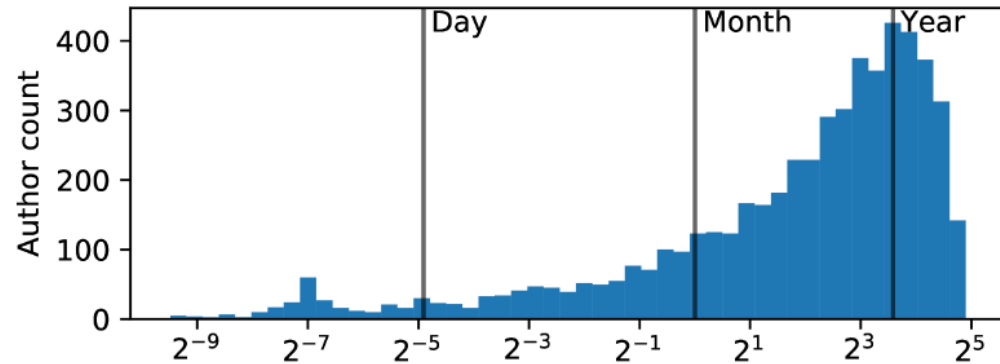
RQ1 (Initiations) Method (Cont'd)

RQ1a: Who? Initiating authors

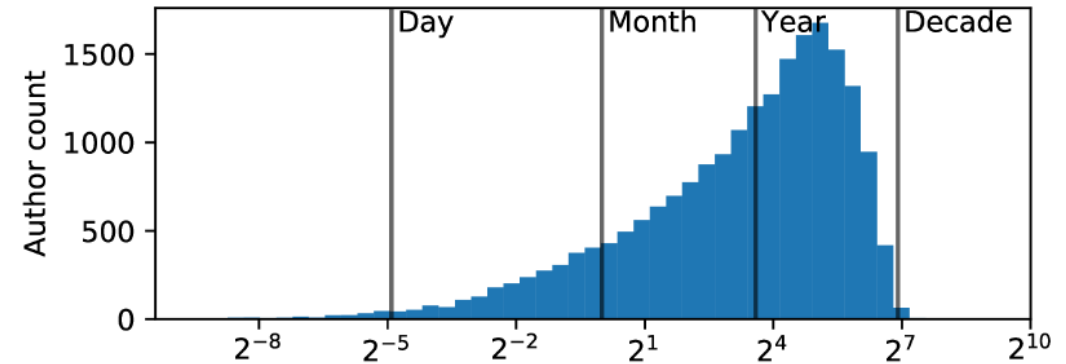
- **11.7% author : first initiation** more than 1 year from their first update.
- **2.4% author : first interacted** with more than 1 year from their first update.
- ***Features*** : Author role,
Binary indicators(**mixed-site?** Multi-site author?),
Total number of updates,
Health condition.

RQ1 (Initiations) Method (Cont'd)

RQ1b: When? Initiation timing



(a) Pre-authorship initiators ($n=5,439$): Time between first initiation and first authored update



(b) Post-authorship initiators ($n=20,687$): Time between first authored update and first initiation

Fig. 5. Distribution of time between first authorship and first initiation. For pre-authorship initiators, the median time to authorship is 5.8 months (mean 7.8mos). For post-authorship initiators, the median time to initiation is 13.6 months (mean 22.3mos).

- **Features** : Total active time (author's first update ~ last recorded update)

RQ1 (Initiations) Method (Cont'd)

RQ1c: With whom? Initiation target

- **Conditional Multinomial Logit Models**
- ***Features* : Network features** (outdegree, indegree, reciprocation, ...)
 - Author role features** : 1 : initiator == candidate / multi, mixed site?
 - Activity features** : number of days since first update ...
 - Health condition features** : 1 : initiator and candidate's non health condition

RQ2 (Relationships) Method (Cont'd)

RQ2a: Reciprocation

- **Logistic model** : predict if the receiving author will reciprocate

RQ2b: Relationships

- ***Number of interactions*** : Negative binomial regression model (count)
- ***Relationship balance*** : binary logistic regression model
(**balanced** : no author made more than 75% of the interactions in relationship)

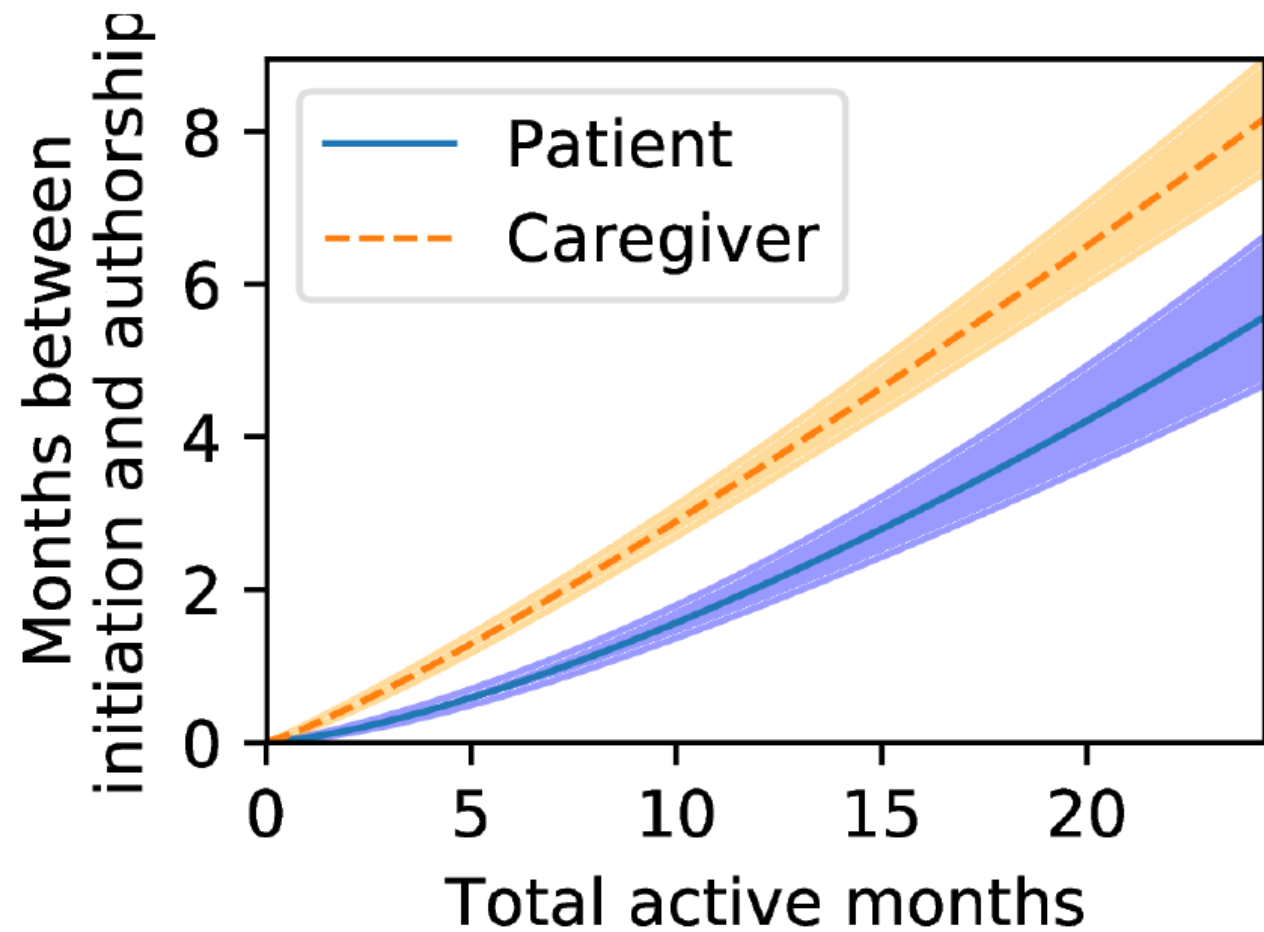
3. Result

RQ1a Results: Who initiates?

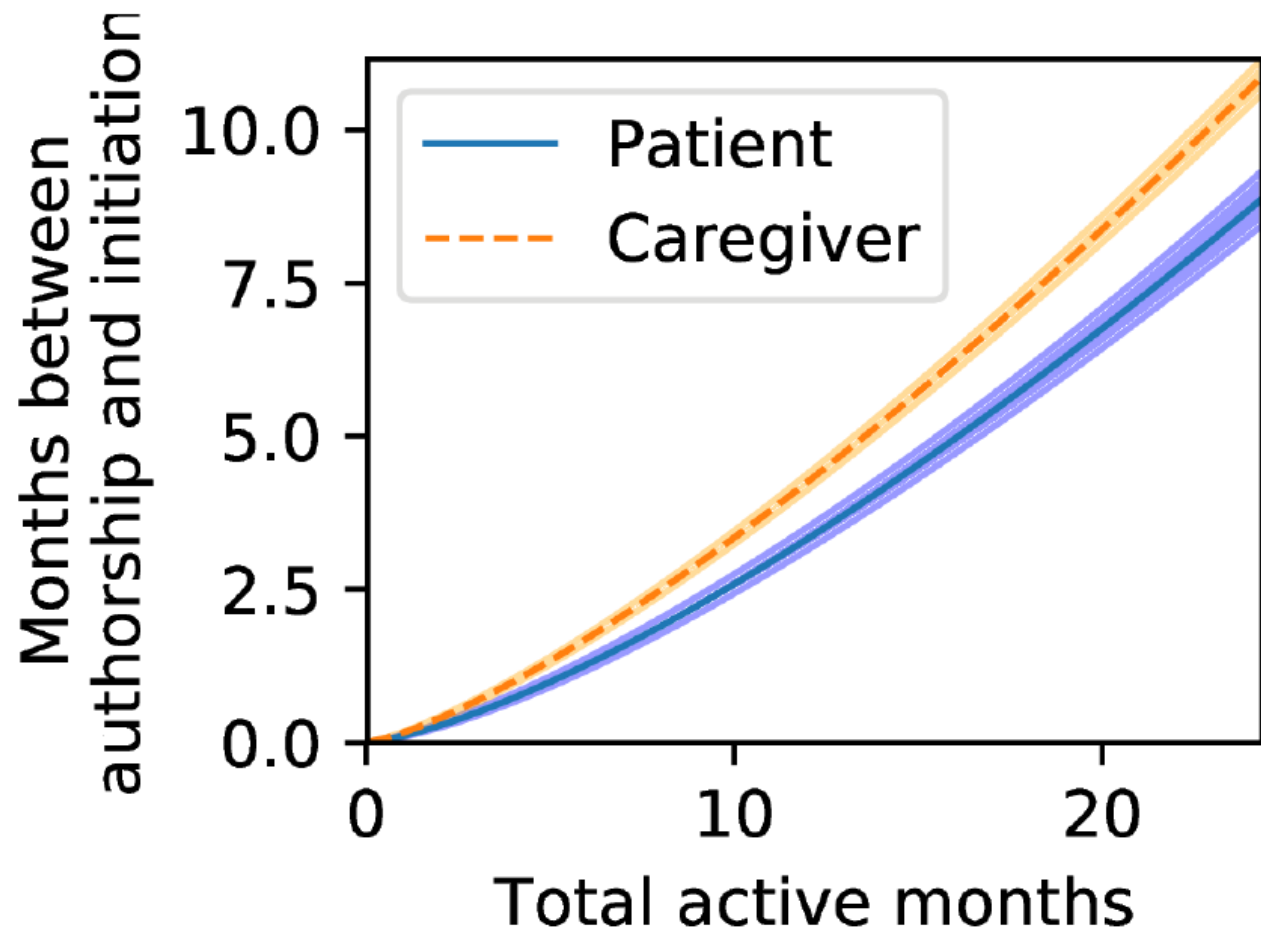
Feature	Coef.	Std.Err.	t	P> t	[0.025	0.975]
Intercept	-0.9049	0.0163	-55.4107	0.0000	-0.9369	-0.8729
Role = Mixed	-0.2979	0.0648	-4.5992	0.0000	-0.4248	-0.1709
Role = P	-0.2962	0.0400	-7.3971	0.0000	-0.3747	-0.2177
Is interacted with?	1.0857	0.0212	51.2408	0.0000	1.0441	1.1272
Role = Mixed : Int'ed with?	0.4356	0.0825	5.2807	0.0000	0.2739	0.5972
Role = P : Int'ed with?	0.5932	0.0504	11.7622	0.0000	0.4943	0.6920

Table 4. Logistic regression model predicting if an author will initiate with other authors. P authors are less likely than CG authors to initiate in the absence of interactions. Both P and CG become much more likely to initiate if interacted with (182% increase in the odds of initiating), but this effect is stronger for P than for CG. (Observations = 53,335, model d.f. = 5, log-likelihood = -34,147, test accuracy = 67.9%)

RQ1b Results: When?



(a) Pre-authorship initiators ($n = 5439$)



(b) Post-authorship initiators ($n = 20687$)

RQ1c Results: With whom?

- **Accuracy : 77.3%**

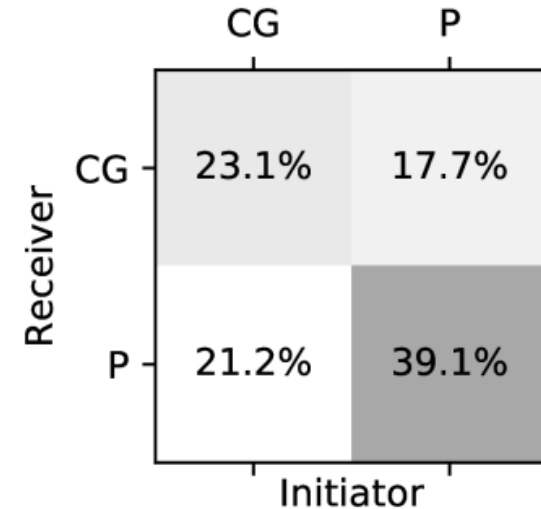
- Initiations are more likely to occur
between same role users.

	(1) All	(2) Network	(3) Role	(4) Activity
Candidate out-degree (log)	-0.191* (0.005)	-0.510* (0.004)		
Has in-degree?	0.756* (0.017)	0.995* (0.013)		
Candidate in-degree (log)	0.649* (0.005)	0.674* (0.003)		
Is reciprocal?	20.016* (0.460)	13.068* (0.174)		
Is weakly connected?	1.767* (0.021)	2.454* (0.021)		
Is friend-of-friend?	5.220* (0.097)	4.881* (0.050)		
Candidate Role = Mixed	0.020 (0.018)		0.095* (0.012)	
Candidate Role = P	-0.242* (0.012)		0.124* (0.008)	
Same author role?	0.299* (0.012)		0.371* (0.008)	
Candidate multi-site author?	0.315* (0.015)		0.249* (0.010)	
Candidate mixed-site author?	0.474* (0.008)		1.365* (0.005)	
Candidate update count	-0.0003* (0.00004)			0.001* (0.00002)
Candidate update frequency	0.007* (0.0002)			0.004* (0.0002)
Days since recent update	-0.011* (0.00005)			-0.013* (0.00005)
Days since first update	-0.001* (0.00001)			-0.001* (0.00001)
Same health condition?	0.213* (0.009)			
Observations	155,141	155,141	155,141	155,141
Log Likelihood	-133,746.600	-353,610.400	-465,555.600	-206,743.700
Test accuracy	77.3%	32.4%	9.8%	73.3%

RQ2a Results: Reciprocations

Feature	Coef.	Std.Err.
Intercept	-2.320	0.008
Initiator Role = Mixed	-0.090	0.016
Initiator Role = P	-0.332	0.013
Receiver Role = Mixed	-0.178	0.017
Receiver Role = P	-0.110	0.015
Init. Role = Mixed : Rcvr. Role = Mixed	0.597	0.043
Init. Role = P : Rcvr. Role = Mixed	0.687	0.034
Init. Role = Mixed : Rcvr. Role = P	0.630	0.036
Init. Role = P : Rcvr. Role = P	1.204	0.025
Was init. author?	1.115	0.010
Was init. author? : Months after first init. update	-0.310	0.002
Months after first rcvr. update	0.036	0.002

Reciprocation Probs



RQ2b Results: Relationships

- ***Number of Interactions*** : More interactions when authors have **same role**.
(Patient/Patient > Caregiver/Caregiver (10.7%))
- ***Relationship Balance*** :
Same author role → 12% increase in the odds of a relationship being balanced.
(52.47% : balanced)

RQ	Result	Sec.
RQ1a	Among non-receivers, caregivers are more likely to initiate than patients; among receivers, patients are more likely to initiate than caregivers.	6.2
RQ1b	Compared to caregivers, patients initiate sooner after becoming an author.	6.3
RQ1c	Initiations are more likely to occur between two authors who have the same role.	6.4
RQ2a	Authors are more likely to reciprocate an initiation when the initiator and the receiver have the same role.	6.5
RQ2b	Reciprocated relationships have more interactions and are more balanced when authors have the same role.	6.6

Table 10. Summary of results.