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Trajectories of Follow-up Compliance and their Predictors in a Fracture Liaison Service

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INTRODUCTION

- Fracture Liaison Services (FLSs) are secondary fracture prevention programs aiming to improve fragility fracture (FF) care and decrease the care gap in osteoporosis[1].
- A systematic follow-up of FLS patients could help reduce the rate of subsequent FF.
- The identification of trajectory groups of patients following similar trajectories of care could be useful for the implementation of such health services.

Objective: The authors aimed to assess follow-up visit compliance patterns of patients with FF in a high-intensity FLS by identifying groups of trajectories of care .

METHODS

Cohort definition

- This is a prospective cohort study of 532 women and men.
- From June 2010 to July 2013, after consent, FF patients were recruited in two hospital-based outpatient orthopedic clinics in Montreal (Canada) and systematically followed in a FLS[2].

Case definition

- Inclusion criteria: Women and men aged 40 years and over, with a fracture that occurred spontaneously or of a minor trauma.
- Exclusion criteria: Patients with an open fracture, craniofacial, hand/foot fracture, major trauma fracture, pathological fracture, severe kidney failure, dementia, with a child or breastfeeding, unable to fill a survey.

Data sources

- Clinical data was collected during the study visits with patient testimony, medical files, pharmacy lists, radiological assessment and blood tests.
- Administrative data on health services and hospitalizations was retrieved from the Régie de l'Assurance Maladie du Québec (RAMQ-Med-Echo). Data was available up to 5 years before baseline.

Intervention

- FLS personnel identified FF patients.
- Participants were clinically assessed for bone fragility using bone mineral density (BMD), spine X-rays, blood testing and the FRAX tool for fracture risk assessment.
- When applicable, osteoporosis therapy along with calcium and vitamin D supplements were prescribed.
- FLS nurses monitored alcohol and tobacco use, physical activity, comorbidities, co-medication, adverse drug reactions and patient-reported adherence to therapy during systematic follow-up visits with patients.
- Quality of life, functional capacity and pain were monitored using self-administered questionnaires at baseline and during follow-up visits.

Outcomes

- The primary outcome was the identification of trajectory groups of compliance to follow-up visits.
- Compliance to follow-up visits was a time-dependant dichotomous variable: when a participant attended a visit = 1, when a patient missed a visit = 0. This was done for all follow-up visits over time (3, 6, 12, 18, 24 months).
- A secondary outcome was the identification of predictors of being in a follow-up compliance trajectory group.

Statistical analyses

- Group-based trajectory modeling (GBTM)[3] was used to identify trajectory groups. Apart from estimating group membership probabilities, all subjects were assigned a trajectory group based on the maximum posterior probability assignment rule. GBTM steps include:
  - Identification of the number of trajectories → 2 to 5 groups were tested with cubic functions of time as to maximize the Bayesian Information Criterion and with a constraint that probability of group membership was 5% or more;
  - From the 3-group analysis selected, the functions of time were varied so the highest order term was statistically significant with *p*-value≤0.05.
- The adequacy of the model was validated using three diagnostic methods[4]: 1) the average posterior probability of assignment had to be at least 0.7; 2) the odds of correct classification had to be >5; 2) the estimated group probabilities had to be similar to the proportions of groups' assignment.
- After the identification of trajectory groups, baseline characteristics of patients were presented and compared between the three groups. Categorical variables were compared using standard Chi-square tests. Continuous variables were presented as means (standard deviations) for normal distributions and as medians (interquartile range) for skewed distributions. They were compared using Student T tests or Wilcoxon-Mann-Whitney tests.
- Predictors of being in a trajectory group were identified using crude and adjusted multinomial logistic regressions. Variables selected for the adjusted analysis were those statistically significant using *p* value ≤0.1 and those judged as clinically significant. Multiple imputation was performed to account for missing data[5].
- Analyses were carried out using SAS software version 9.4 (SAS Institute Inc., Cary, NC, USA).

FIGURE I: Trajectory curves of follow-up visit compliance during a 2-year follow-up in a FLS. Dashed lines: group-membership probabilities with 95% confidence intervals. Complete lines: group-membership individual estimation.

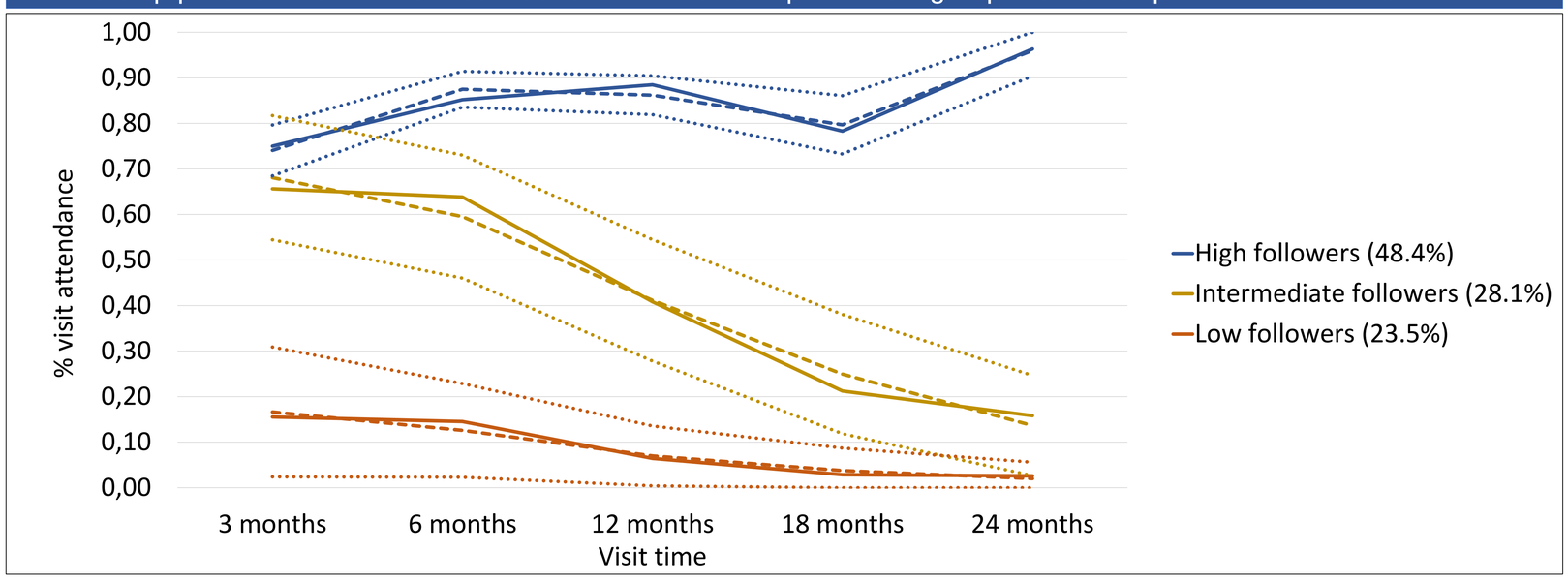

TABLE I: Baseline characteristics according to follow-up visit compliance trajectory groups

Baseline characteristics	Trajectories						p-value ≤ 0.05
	High followers		Intermediate followers		Low followers		
Number of patients, %	260	48.9	110	20.7	162	30.4	
Female gender, n (%)	222	85.4	95	86.4	139	85.8	-
Age, mean ± SD	64.1	10.3	61.8	12.5	63.3	11.8	-
BMD femoral T-score, n (%)µ	249	95.8	104	94.5	105	64.8	
Mean±SD	-1.69	0.89	-1.5	1.08	-1.41	1.01	H vs L
Normal, n(%)	40	16.1	30	28.9	33	31.4	H vs I H vs L
Osteopenia, n(%)	171	68.6	56	53.8	58	55.2	
Osteoporosis, n(%)	38	15.3	18	17.3	14	13.3	
BMD vertebral T-score, n (%)µ	251	96.5	104	95.4	104	64.2	
Mean ± SD	-1.81	1.35	-1.59	1.31	-1.57	1.42	-
Normal, n(%)	67	26.7	29	27.9	31	29.8	-
Osteopenia, n(%)	98	39.0	50	48.1	44	42.3	
Osteoporosis, n(%)	86	34.3	25	24.0	29	27.9	
BMI, n (%)µ	259	99.6	110	100.0	160	98.8	
Mean ± SD	25.8	5.4	26.5	5.8	25.8	5.1	-
Previous exposure to OP treatment, n (%)	54	20.8	24	21.8	21	13.0	H vs L
Prior fracture history, n(%)	92	35.4	39	35.4	44	27.2	-
Number of drugs, median (IQR)	5.0	2.0-8.0	5.0	2.0-8.0	3.0	1.0-6.0	H vs L I vs L
n>5 (%)	117	45.0	48	43.6	47	29.0	H vs L I vs L
Major incident fracture, n (%)†	163	62.7	68	61.8	108	66.7	-
Charlson comorbidity score, median (IQR)‡	1.0	0.0-3.0	1.0	0.0-2.0	0.5	0.0-3.0	-
CCS: n≥1 (%)	133	51.1	58	52.7	81	50.0	-
CCS: n≥2 (%)	107	41.1	42	38.2	64	39.5	-
CCS: n≥3 (%)	67	25.8	25	22.7	41	25.3	-
Referred at baseline, n (%)	69	26.5	42	38.2	32	19.7	H vs I I vs L
Present smoking, n (%)µ	259	99.6	107	97.3	162	100.0	
Yes, n (%)	41	15.8	21	19.6	34	21.0	-
Major FRAX score, n (%)µ	259	99.6	110	100.0	160	98.8	
median (IQR)	11.0	7.3-17.0	9.7	6.3-16.0	10.0	6.5-16.5	-
≤10%	119	45.9	56	50.9	81	50.6	-
11-19%	94	36.3	33	30.0	46	28.8	
≥20%	46	17.8	21	19.1	33	20.6	
Hip FRAX score, n (%)µ	259	99.6	110	100.0	160	98.8	
median (IQR)	1.8	0.7-4.4	1.5	0.5-3.8	1.4	0.5-5.0	-
<3%	171	66.0	72	65.5	106	66.3	-
≥3%	88	34.0	38	34.5	54	33.7	
Comorbidities, n (%)‡							
Osteoporosis	91	35.0	39	35.4	44	27.2	-
Hypertension	128	49.2	44	40.0	73	45.1	-
Diabetes	37	14.2	19	17.3	21	13.0	-
Hypothyroidism	40	15.4	16	14.6	14	8.6	H vs L
Dyslipidemia	72	27.7	30	27.3	34	21.0	-
E/G diseases	33	12.7	19	17.3	20	12.3	-
AI diseases	28	10.8	11	10.0	13	8.0	-

Abbreviations: (AI) abdominal inflammatory, (BMD) bone mineral density, (BMI) body mass index, (E/G) esophageal/gastro-protective, (FLS) Fracture Liaison Service, (H) high followers, (I) intermediate followers, (IQR) inter-quartile range, (L) low followers, (n) number, (OP) osteoporosis, (SD) standard deviation.
µ Number of patients with data available.
† Major fractures included hip, spine, proximal humerus and wrist sites. Other fractures referred to the rest of fracture sites.
‡ Data retrieved from administrative databases on physician-billing medical services and hospitalization data with ICD-9/10 codes.

References

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Disclosures
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TABLE 2: Results of adjusted multinomial logistic regression to identify predictors of membership to follow-up visit compliance trajectory groups

Baseline characteristics	Adjusted			
	High followers vs Low followers		Intermediate followers vs Low followers	
	aOR	95%CI	aOR	95%CI
Gender (male vs female)	0.96	(0.53-1.75)	0.93	(0.44-1.95)
Age	0.99	(0.97-1.01)	0.98	(0.95-1.01)
BMD femoral T-score				
Osteopenia vs normal	2.85	(1.60-5.06)*	1.23	(0.64-2.36)
Osteoporosis vs normal	1.87	(0.86-4.09)	1.21	(0.49-2.98)
Previous exposure to OP treatment	1.34	(0.67-2.67)	1.23	(0.54-2.79)
Prior fracture history	1.26	(0.79-2.00)	1.30	(0.74-2.27)
Number of drugs				
>5 vs ≤5	2.26	(1.39-3.66)*	2.14	(1.19-3.86)*
Incident fracture type†				
Major vs other	0.75	(0.48-1.18)	0.85	(0.49-1.45)
Charlson comorbidity score‡ : n≥1	0.85	(0.55-1.31)	1.03	(0.60-1.75)
Referred at baseline	1.12	(0.62-2.02)	1.98	(1.01-3.89)*

Abbreviations: (AI) abdominal inflammatory, (BMD) bone mineral density, (BMI) body mass index, (CI) confidence interval, (E/G) esophageal/gastro-protective, (FLS) Fracture Liaison Service, (OP) osteoporosis, (OR) odds-ratio.
Note: Multiple imputation method (n=50) performed on femoral and vertebral BMD, major and hip FRAX, BMI and smoking status to obtain estimates free of missing data.
†Major fractures included hip, spine, proximal humerus and wrist sites. Other fractures referred to the rest of fracture sites.
‡ Data retrieved from administrative databases on physician-billing medical services and hospitalization data with ICD-9/10 codes.
* p<0.05

RESULTS

Identification of trajectory groups

- ✓ The identified trajectories of compliance to follow-up visits in the FLS and their predicted probabilities of group membership are shown in Figure 1.
- ✓ The Bayesian Information Criterion was maximized at -1549.42 with three trajectories, and two linear and one cubic trajectories resulted in a BIC of -1541.41 (maximized).
- ✓ As shown in Table 1, 48.9% of patients were assigned to the high followers (HF) trajectory group, 20.7% to the intermediate followers (IF) trajectory group, and 30.4% to the low followers (LF) trajectory group.
- ✓ All diagnostic requirements were respected.

Predictors of being in a trajectory group

- ✓ With respect to the probability of being in the LF group, having osteopenia compared to normal BMD and polypharmacy (>5 drugs) were predictors of being in the HF group (Table 2).
- ✓ With respect to the probability of being in the LF group, being referred to a bone specialist and polypharmacy were predictors of being in the IF group (Table 2).

CONCLUSION

- ✓ Despite a high-intensity intervention, half the FLS patients will have an intermediate or low follow-up compliance pattern.
- ✓ Setting of secondary prevention where subsequent FF risk is increased → Investigating the behavioural patterns of follow-up compliance with patient-centered research may help understand this phenomenon.
- ✓ Limitations: observational study and analysis restricted to an urban region of one province in Canada, which could limit the generalizability of results.
- ✓ These trajectory groups of follow-up compliance can probably affect the cost-effectiveness of such a program. See poster **PMS21-S10** for more information!