Medical Research Archives

ESMED
European Society of Medicine

OPEN ACCESS

Published: January 31, 2023

Citation: Olenginski T. P., 2023. Geisinger High-Risk Osteoporosis Clinic: Narrowing Post-Fracture Care Gaps and Lessons Learned, Medical Research Archives, [online] 11(1). https://doi.org/10.18103/mra.v11i1.3481

DOI: https://doi.org/10.18103/mra.v11i1.3481

ISSN: 2375-1924

RESEARCH ARTICLE

Geisinger High-Risk Osteoporosis Clinic: Narrowing Post-Fracture Care Gaps and Lessons Learned

Thomas P. Olenginski

Geisinger Department of Rheumatology, Danville, PA, USA

tpolenginski@geisinger.edu

ABSTRACT

Background: In 2008, Geisinger Rheumatology established a Fracture Liaison Service (FLS) termed HiROC (High-Risk Osteoporosis Clinic). Inpatient HiROC teams integrated with outpatient HiROC clinics.

Aim: We review the history of Geisinger HiROC, performance and lessons learned. We examine this: In a high-risk, post-fracture, drug-indicated patient without treatment contraindications, was patient treated? If a patient chose followup with Geisinger primary care physician (PCP), was that patient treated?

Results: Four Geisinger HiROC analyses are presented: 2008-2011; 2013-2015;2016; and 2017-2018. HiROC treatment rates are 80 %, 75.4 %, 74 %, and 72 %, respectively. Geisinger PCP treatment rates are 32.2 %, 13.8 %, and 14 %. (PCP data from 2017-2018 not included)

2008-2011 analysis included 888 patients, mean age 76.1, 77.6 % women and 22.4 % men. Mean 25-OH Vit. D was 25.6. Hip fractures represented 58.2 % of cohort and vertebral fractures (VF) 11.6 %. At discharge, 44.3 % went to Rehab, 31.5 % to Nursing Home (NH) and 24 % home. Six- month mortality was 14.7 % and HiROC followup 51.5 %.

2013-2015 analysis included 1279 patients with mean age of 77.8 and 74 % women, 26 % men. Hip fractures were seen in 67.6 % and VF in 6.6 % and mean 25-OH Vit. D was 25.8. Patients chose HiROC 42.6 %, 37 % HiROC patients were lost to followup, and 6 month mortality was 16 %. GHP insured 27.4 % and within GHP-insured patients, HiROC treated 74.7 % versus 19.7 % by Geisinger PCP.

In 2016, we reported 380 patients, mean age 78, 69 % women, 31 % men. Hip fractures accounted for 74.5 %, VF 6.6 %, with mean 25-OH Vit.D 25.8 and 17 % six month mortality. Patients chose HiROC 46 % of time. HiROC initiated treatment in 74 % compared with 14 % by Geisinger PCP.

2017-2018 analysis included 740 patients, mean age 78, with 89 % women and 11 % men. Hip fractures accounted for 78 % and VF 6.6 %. HiROC was chosen by 45 % patients and 6-month mortality was 14 %. HiROC initiated treatment 72 % of time.

Conclusions: Geisinger HiROC treated high-risk, post-fractured, drug indicated patients 72 - 80 % of time, far superior to Geisinger PCP rates of 13.8 - 32.2 %.

Introduction

Gaps in the care of Osteoporosis have been recognized internationally and by most bone health organizations, especially the Bone Health and Osteoporosis Foundation (BHOF) and International Osteoporosis Foundation (IOF), Own the Bone and others[1-7]. The care gaps span osteoporosis screening, drug initiation rates, recognition of the importance of osteoporosis and fragility fractures, lack of diagnostic coding, post-fracture case finding (both inpatient and outpatient), drug initiation post-fracture, post-fracture outpatient followup, misdiagnosis and undertreatment of glucocorticoid-induced osteoporosis (GIOP), etc.[1-7]. Rheumatology has been the leader in Geisinger Osteoporosis care initiatives. In 2001, our Mobile DXA Program began providing on-site DXA services to Geisinger primary care offices[8]. This program saved patients time, travel expense, and was highly rated by patients and on site primary care physicians (PCP). Importantly, we interpreted DXA's in a clinical consultative fashion, as opposed to our Radiologists, who used a "Results Only" method. In high-risk patients, who met criteria for osteoporosis treatment and had a Mobile DXA, 75% of patients were initiated on drug treatment after receiving Mobile DXA clinical report. This as opposed to 50% of the time when receiving a Radiology 'Results Only' DXA report[9]. Additionally, we implemented a novel GIOP program designed to better educate, help, and treat patients prescribed chronic glucocorticoid therapy[10]. GIOP program participants retained the education provided and had increased drug initiation rates[10].

Our true challenge and focus was post-fracture care as we continued to read of post-fractured patients not receiving medical evaluations and not being treated with drugs shown to reduce future fracture risk. In many institutions, providers are not notified when patients are admitted to hospital for hip or other fractures. Teaming with Orthopedics, Hospitalist Medicine, Emergency Medicine, Trauma Surgery, and Spine Surgery, we worked cooperatively to reach consensus on development of a Fracture Liaison Service (FLS) Pathway, termed HiROC – High Risk Osteoporosis Clinic[11]. All fracture admitting services would have admission orders allowing auto-notification of a HiROC fracture consult. Rheumatology would see the patient, evaluate and assess, educate on osteoporosis and fracture risk and the need for outpatient care and drug treatment. HiROC was established at our 2 flagship hospitals, Geisinger Medical Center (GMC), Danville and Geisinger Wyoming Valley (GWV), Wilkes Barre. At discharge, plans were made to have patient scheduled in one of our HiROC clinics, which were accessible throughout our health system. It was critical to integrate post-fractured patients into outpatient Rheumatology care, initiate indicated treatments, and provide followup care. We utilized Microsoft Access database to register patients, track and measure performance. Nine months into program startup, we hired a Database Coordinator to join our HiROC team. Our two Rheumatology Nurse Specialists were unable to manage the database, scheduling, tracking and clinical care of our patients as our program grew. The

most important measure that we held our team accountable to was the percentage of High-Risk patients treated with osteoporosis medication. In the USA, while there are important publications regarding FLS initiatives, few programs have continually audited their performance like the Fracture Liaison Service Database (FLS-DB) in United Kingdom and Wales. In this manuscript, we present 4 time-period analyses within Geisinger HiROC: 2008-2011, 2013-2015, 2016, and 2017-2018. We show the reader the consistent, excellent performance we have measured. Additionally, we discuss barriers to optimal HiROC care, barriers that similarly interfere with other FLS programs' efficiency and efficacy[12-17]. In so doing, we aim to stimulate the development of more FLS Programs and to show how Geisinger's program has evolved.

Methods

At inception of Geisinger's HiROC program, we utilized a Microsoft Access Program to serve as our FLS Registry and functional database. With our first program analysis, we had a Geisinger research analyst and statistician provide the following information from time-period 2008-2011: demographics (sex, age, fracture site, mortality at 6 months post-fracture, discharge disposition); fracture risk; treatment in HiROC or by Geisinger PCP; vitamin D level. Importantly, because not all patients chose to be followed in HiROC , we were able to document the treatment rates in HiROC versus Geisinger PCP. Programatically, we planned for the first analysis at 6 months post fracture. Subsequently, all other analyses were done under supervision of HiROC physician lead (TPO). These analyses were done from time periods 2013-2015; 2016; and 2017-2018. Our database coordinator provided the patient medical record numbers for each time period. We prepared an excel spreadsheet and tabulated the following: age, sex, GHP Insurance, deaths, fracture risk, disposition, and treatment rates: HiROC versus PCP. It became very clear that about 50% of fractured patients chose to follow with HiROC, while the rest followed with their PCP (Geisinger or non-Geisinger), allowing us to document HiROC drug treatment rates versus Geisinger PCP treatment rates. We were unable to capture any data from patients following with non-Geisinger PCP's. It is important to emphasize that to perform these analyses, we searched each patient's medical record for the data metrics and entered this into the excel spreadsheet for each corresponding time period. The benchmark of highest importance was the treatment rates of high-risk, drug eligible patients in HiROC care or Geisinger PCP care.

Results

Geisinger HiROC's first performance analysis involved 888 patients (Table 1), seen from 2008-2011, with 77.6% women and 22.4% men and mean age 76.1 (range 21 to 99). Fracture sites are tabulated, with hip fractures accounting for 58.2% and vertebral 11.6%. While HiROC was initially designed for hip fractures, our surgical partners began consulting us on other fractures, as listed in Table 1. Mean vitamin D level in hospital was 25.6 units. Patient disposition at discharge

included: 44.3% patients to Rehab Facility, 31.5% to Nursing Home, and 24% returned home[11].

Table 1: Inpatient HiROC Summary 2008-2011 (N = 888)

Variable	Number/Percentage (%)
Sex	
Female	689 (77.6%)
Male	199 (22.4%)
Age	
Mean	76.1
Median	79.1
Range	21.3 – 99.6
Fracture Sites	
Hip	517 (58.2%)
Other	177 (19.9%)
Vertebral	103 (11.6%)
Pelvic	41 (4.6%)
Distal Femur	33 (3.7%)
Periprosthetic	31 (3.5%)
Wrist	20 (2.3%)
Midshaft Femur	15 (1.7%)
Femur Subtrochanteric	14 (1.6%)
Baseline Vitamin D	
Mean	25.6 ng/mL
Median	24.5 ng/mL
Range	4-150 ng/mL
Discharge Disposition	
Rehab Facility	393 (44.3%)
Nursing Home	280 (31.5%)
Home	213 (24%)
Readmission	1 (0.1%)
Hospice	1 (0.1%)

As shown in Table 2, we decided to initially analyze metrics at 6 months post-fracture and our 2008-2011 data showed 76.1% were High-Risk, meeting one of the following criteria used in HiROC care: clinical hip or vertebral fracture; T-score less than or equal to -2.5; Low Bone Mass with Major Osteoporosis Fracture Risk 20% or more

and/or Hip Fracture Risk 3% or more; Low Bone Mass and either wrist, humerus, or pelvic fracture; or patients meeting treatment thresholds of ACR 2010 GIOP Guidelines (later, ACR 2017 GIOP Guidelines) 18,19. We observed that patients did not always choose to followup in HiROC for post-fracture osteoporosis care, with 51.5% in HiROC and the rest in primary care (24% with non-Geisinger PCP and 13% with Geisinger PCP). Treatments used included oral bisphosphonates 52%, IV zoledronic acid 35.3%, teriparatide 6.6% and denosumab 4.4%. A 14.7% mortality rate was identified at the first six month post-fracture mark[11].

Table 2: 2008-2011: Clinical Data at 6 Months

Variable	Number/Percentage (%)
Fracture Risk	
High	676 (76.1%)
Low	54 (6.1%)
Unknown	84 (9.5%)
Not Done	74 (8.3%)
Follow up Care	
HiROC	457
Non-Geisinger PCP	214
Geisinger PCP	118
Other	89
Hospice	10
Six Month Mortality	14.7%
Drug Prescribed (N=365)	
Oral Bisphosphonate	190
Zoledronic Acid	129
Teriparatide	24
Denosumab	16
Other	6
Vitamin D Level	
Mean	31.6 ng/mL
Median	29.1 ng/mL
Range	4 – 130 ng/mL

Table 3 illustrates post-fracture treatment rates among patients eligible for treatment and with no contraindications. Within Geisinger HiROC care, 80% of drug eligible patients were treated compared with 32.2% by Geisinger PCP[11].

Table 3: 2008-2011 Follow up Care: HiROC versus Geisinger PCP (N = 472)

Variable	N = 472	HiROC N = 382	Geisinger PCP N = 90
Sex			
Female	371	299	72
Male	101	83	18
Age			
Mean	77.6	76.8	81.2
Median	80.2	79.5	83.8
Range	29.5 – 97.5	29.5 – 97.5	47.4 – 97.3
Was patient treated?			
Yes	337	308 (80.6%)	29 (32.2%)
No	122	70 (18.3%)	52 (57.8%)
Unknown	13	4 (1.1%)	9 (10%)

Our second analysis included performance data from 2013-2015. Table 4 shows our population of 1279 patients, 74% women and 26% men with mean age of 77.8 (range 20-100). Fracture sites included hip in 67.6% and Vertebral in 6.6% and others as listed[20]. Mean vitamin D level was 25.8 units[20].

Table 4: 2013-2015 Consultations (N = 1279)

Variable	Number/Percentage (%)
Sex	
Female	942 (74%)
Male	337 (26%)
Age	
Mean	77.8
Range	20.8 – 100.8
Fracture Site	
Hip	864 (67.6%)
Other	136 (10.6%)
Vertebral	85 (6.6%)
Periprosthetic	44 (3.4%)
Femur Subtrochanteric	44 (3.4%)
Pelvic	38 (3.0%)

Variable	Number/Percentage (%)
Distal Femur	38 (3.0%)
Midshaft Femur	14 (1.1%)
Wrist	11 (0.9%)
Vitamin D	
Mean	25.8 ng/mL
Range	5 – 99 ng/mL

As seen in Table 5, Programmatic six month post-fracture analysis showed that 83.6% were High-Risk. Patients chose HiROC followup in 42.6% cases. Amongst the patients who chose PCP followup, 20.7% were followed by non-Geisinger PCP and 18.5% followed by Geisinger PCP. Importantly, 16% of patients died on or before 6 month post-fracture timepoint[20].

Table 5: 2013 – 2015 HiROC Data at 6 months Post-Fracture

Variable	Number/Percentage (%)
Fracture Risk	
High	1069 (83.6%)
Unknown	134 (10.5%)
Low	76 (5.9%)
Follow-Care Location	
HiROC	545 (42.6%)
Non-Geisinger PCP	264 (20.7%)
Geisinger PCP	237 (18.5%)
Death	2017 (16.1%)
Other	26 (2.0%)
Drug Treatment	
Oral Bisphosphonate	223 (51.9%)
Zoledronic Acid	111 (25.8%)
Denosumab	71 (16.5%)
Teriparatide	21 (4.9%)
Raloxifene	4 (0.9%)
Vitamin D level	
Mean	34.4 ng/mL
Range	5-99 ng/

Table 6 analyzes treatment rates and we document that HiROC patients were treated 75.4% of time but Geisinger PCP patients only 13.8% of time. Additionally, we analyzed the treatment rates amongst Geisinger Health Plan (GHP) insured high-risk patients, as they accounted for 27.4% of entire cohort. GHP patients followed in HiROC were treated 74.7% of time, while GHP patients followed by Geisinger PCP's were treated only 19.7% of time. Surprisingly, we determined that 37% of HiROC patients were lost to followup between 2013-2015[20].

Table 6: 2013 – 2015 HiROC Treatment Rates and Lost to Followup

Variable	Number/Percentage (%)
Treatment Eligible Patients	
HiROC	448
Geisinger PCP	196
Treatment Rates	
HiROC	338 (75.4%)
Geisinger-PCP	27 (13.8%)
GHP-Insured Patients	351 (27.4%)
GHP-insured Treatment Rates	
HiROC	115 (74.7%)
Geisinger PCP	15 (19.7%)
Lost to HiROC Follow up	117 (37.4%)

Our 2016 analysis was presented at the 2018 Interdisciplinary Symposium on Osteoporosis (ISO), including details on 380 patients, 69% women and 31% men. Mean age was 78 with 74.5% sustaining hip fractures and 6.6% vertebral fractures. We identified 36% of cohort with GHP insurance, while 93% were high-risk, drug-eligible. HiROC followup was chosen by 46%, while 17.1% were followed by non-Geisinger PCP and 13.9% patients by Geisinger PCP. Six month mortality was 17%. Treatment initiation rates were 74% in HiROC care versus 14% by Geisinger PCP[21].

Our final time period analysis was 2017-2018 and this analysis can be viewed in Table 7. The data was accepted for presentation at 2019 American College of Rheumatology (ACR) meeting. The population included 740 patients, 89% women and 11% men, mean age 78, with 78% hip fractures and 5.3% vertebral fractures. GHP insurance was documented in 35% patients. Followup in HiROC was chosen by 45% patients. HiROC patients were treated 72% of time and six month mortality was 14%. We chose not to analyze any PCP data in this time period[22].

Table 7: HiROC 2017-2018 Demographics, Variables, and Performance

Variable	Number/Percentage (%)
Total Patients	740
Mean Age	78
Women	545 (74%)
Men	195 (26%)
HiROC Follow up	336 (45%)
HiROC Treatment Eligible	228
HiROC Patients Treated	207 (72%)
Zoledronic Acid	73 (35%)
Oral Bisphosphonate	70 (34%)
Denosumab	54 (26%)
Anabolic agent	10 (5%)
Early Mortality	105 (14%)
Later Deaths	53 (7%)
GHP-Insurance	256 (35%)

Discussion

Our results, clearly and consistently, show that over the first decade of our HiROC Program, we treated High-Risk, drug eligible patients 72 - 80% of time, while Geisinger PCP treatment rates were 14 - 32.2%[11,14,20-22]. We did not analyze Geisinger PCP rates during 2017-2018 because we did not expect any real changes in treatment rates and because our focus remained to measure Geisinger HiROC performance. Care gap data influential in our decision to develop HiROC consistently reported that 80% of patients with fracture never receive a medical evaluation and that only 20% of fractured patients are treated with an osteoporosis drug[1-7,23]. Our treatment rates document and emphasize the cooperative efficacy of our FLS program, designed in cooperation with Orthopedic surgeons, Trauma surgeons, Spine surgeons and Hospitalists and Emergency Medicine[11,14,20-22]. Other findings of interest included a sobering six month mortality, measured in each time-period analysis with reported rates of 14.7%, 16%, 17%, and 14% respectively[11,14,20-22]. We report that men accounted for an important percentage of hospital admissions for fracture[11,14,20-22] and that they represented a significant percentage of every analysis - 22.4%, 26%, 31%, and 11% respectively. Previously, we reported on the first 500 men seen in Geisinger HiROC. From 2008-2015, we identified 500 men aged 50 and older who were hospitalized with fracture. Over this time, men accounted for 25% of fracture admissions. Twenty percent of men died on or before the six month post-fracture timepoint.

Forty-four percent of men chose HiROC for followup care. HiROC treated 67% of high-risk men[24]. These observations align with the published reports of increased morbidity and mortality in men after fractures[25-27].

While initially started as hip fracture FLS, our Orthopedic surgeons and other colleagues began consulting Geisinger HiROC on most other fractures (excluding hands, feet, face and skull). Hip fractures accounted for most fractures, with reported rates of 58.2%, 67.6%, 74.5%, and 78% respectively. However, we are consulted on patients with humerus fractures, wrist fractures, pelvic fractures, periprosthetic fractures, distal femur fractures, ankle fractures and tibia and fibula fractures, tibial plateau fractures, and others[11,14,20-22].

It was very surprising and frustrating to find that at discharge, many patients chose to follow with their PCP rather than with HiROC. HiROC followup rates were 51.5%, 42.6%, 46%, and 45%, respectively in our 4 analyses[11,14,20-22]. This occurred despite numerous attempts to schedule patients in HiROC clinics and despite emphasizing the importance of HiROC followup and osteoporosis treatment. These findings indicate issues with suboptimal patient engagement, and we continue to be challenged by this[28-30]. Again, despite superior treatment rates within Geisinger HiROC, many patients chose followup with their PCP. These patients were much less likely to be treated for their underlying osteoporosis[11,14,20-22].

In the 2013-2015 analysis, we analyzed the likelihood of treatment in GHP-insured patients. While a separate entity to the Geisinger Health System, GHP is similarly aligned concerning secondary fracture prevention and quality measures. The fact that HiROC treatment rates in GHP-insured patients were 74.7% compared to 19.7% with Geisinger PCP's again points to the utility and effectiveness of FLS-driven HiROC care. We hoped that reviewing this data might persuade GHP to more effectively align their patients with HiROC[20] and/or incentivize patients to have followup care in HiROC.

While our treatment rates were impressive, we learned many lessons over the first decade of HiROC care. The importance of a 'Program Coordinator' and program database cannot be overemphasized. You cannot manage what you don't measure and certainly, it is hard to improve when you do not know your 'performance'[31-32]. I want to emphasize that within HiROC, the percentage of post-fracture, drug eligible patients treated is our # 1 benchmark, because this exemplifies the highest bar of FLS performance. Now, that is not to say that measurement of 25-OH vitamin D, other secondary lab investigations, DXA, education on calcium and Vitamin D, weight-bearing exercise, home safety, and fall prevention are not important. Treating post-fractured patients, especially after hip or vertebral fractures, is what FLS programs aim to do, and this treatment measure should be the number 1 post-fracture care quality metric. Additionally, it should motivate and challenge all FLS programs to similarly report and audit performance measures and improve[31].

Because of our coordinator, use of our database, and work of our entire HiROC team, we learned of the following barriers to optimal post-fracture care: communication amongst medical and surgical teams; availability of DXA; missed appointments; patient engagement; scheduling; transportation concerns; family support; medical decision-making advocacy; issues with long-term care facilities; losing patients to followup; Covid-19 pandemic; and access to and affordability of medications. For our program to improve, we must address all of these barriers and create effective solutions leading to better efficiency and effectiveness[11,14,20-22]. Other FLS programs cite similar barriers to optimal post-fracture care[33-35].

Finally, we report on changes within our HiROC Program that have created new challenges. Geisinger Information Technology stopped supporting our database and we have not been tracking performance, since mid-2019. This is both regrettable and embarrassing, but Geisinger leadership's challenges and expectations of our general Rheumatology Services coupled with budgetary constraints were important factors. Fortunately, we are soon to inaugurate a new registry within Epic, which will allow more effective patient registration, tracking and reporting. The loss of our database coordinator was another unfortunate happening that occurred despite the successes of HiROC. What we report today could not have happened without such a coordinator, a database, and a committed team, and interdisciplinary cooperation. One of our most experienced Nurse Specialists retired and no replacement was named. Instead, her work was divided amongst our entire physician staff and remaining Nurse Specialist. Requests to integrate Trabecular Bone Score (TBS) into our DXA centers have been denied. Attempts to partner with our Radiology Department to develop a seamless protocol for ordering Biomechanical Computed Tomography (BCT) scans have been inordinately delayed. Finally, the Covid-19 pandemic forced several decisions on our institutional leadership. The most telling was one affecting our clinic infusion center, conveniently located so our patients can be seen and treated in the same Rheumatology clinical area. Our infusion center was closed and existing staff were relocated to work in our Hematology/Oncology Infusion Center. This has been disruptive for many of our patients. Given this, we have worked to make sure our patients have convenient local access for treatment with Zoledronic Acid, Denosumab, and Romosozumab. Since 2020, GHP has empowered their Home Infusion Service nurses to treat GHP-insured patients at home, initially with zoledronic acid and denosumab, but most recently with romosozumab. These observations point to the importance of our overall HiROC team involved in extending osteoporosis care to post-fractured patients across our health system, while having the necessary key resources to help support our patients at all times.

Conclusion

In summary, by developing our HiROC Program around an established outpatient

clinic arm to assure patient access, and with the support of Orthopedics, Trauma Surgery, Spine Surgery, Hospitalists and Emergency Medicine, we have been able to capture most fractures at our 2 major hospitals by case-finding using HiROC Auto-Consultation order sets on fractured patients. Because both Rheumatology clinics are near each hospital, we designed an FLS Program that sees the fractured patient while in the hospital. Here, after evaluation, an initial care plan is formulated and we then coordinate outpatient osteoporosis treatment, with the intent to keep patients under our care[11].

We have shown that we consistently initiate treatment in drug-eligible patients and that our treatment rates are far superior to those rendered within Geisinger primary care. Likewise, these treatment rates are also superior to the estimated 20% of patients who are treated post-fracture[1-3, 23]. We have documented that many patients are discharged to nursing homes, assisted living facilities, Rehabilitation units and their fractures significantly affect their independence and physical function[11]. Importantly, our 6 month post-fracture mortality varies from 14-17%, pointing to the seriousness of osteoporotic fracture and need for better post-fracture care[11,14,20-22]. We emphasize that men comprise a significant portion of our fracture admissions and that their morbidity and mortality is higher than women[24-27].

In addition to tracking performance, databases have other functions. Within the UK and Wales, a yearly audit of the UK FKLS-DB is performed[31,36]. In the USA, Own the Bone has its own database/registry, with 12 benchmarks[37]. No matter what specific registry is used, it is paramount for all FLS programs to identify fractured patients, evaluate them, initiate an individualized therapy, and assure followup care, with the goal of treating 80% or more of post-fractured patients, while continually measuring one's performance and striving for longitudinal followup care of post-fractured patients.

Corresponding author:
Thomas P. Olenginski
Geisinger Department of Rheumatology
Danville, PA, USA
Email: tpolenginski@geisinger.edu

Acknowledgements

I wish to acknowledge the great work and spirit of cooperation that our HiROC team embodies. It is important to highlight and recognize our colleagues in the Northeast (Wilkes Barre/Scranton), in Danville, and in State College and other clinic sites where HiROC care is rendered. Thanks to our receptionists, secretaries, nursing staff, scheduling team, and to our infusion sites and nursing staffs. Special thanks to all Geisinger DXA Centers, staffing, and technologists. I also wish to recognize our Mobile DXA Program, drivers, and technologists. Thanks to Geisinger Home Infusion nurses and staff. Finally, special thanks to Gwynne Maloney-Saxon, RN and to our Orthopedic, Trauma Surgery, Spine Surgery, Hospitalist and ER colleagues.

Conflict of Interest Statement

I have no conflicts of interest related to Geisinger HiROC or the preparation of this manuscript.

Funding

None.

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