

1 A retrospective audit of the timescales involved in the diagnosis and management of
2 suspected Achilles tendon ruptures at a single NHS trust: a quality service improvement and
3 redesign project
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9

10 **Abstract**

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12 **Introduction:** The Achilles tendon is the most frequently ruptured tendon. Prompt diagnosis
13 ensures optimal management decisions are instituted early to ensure the best outcome and
14 patient experience, at minimal cost to the United Kingdom National Health Service. Despite
15 this, regional and national variations to diagnosis and management exist, with anecdotal
16 evidence of inefficiencies in the local patient pathway. To explore this further a retrospective
17 departmental audit of timescales from presentation to ultrasound diagnosis and definitive
18 treatment decision was undertaken.
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22 **Methods:** All suspected Achilles tendon ruptures in 2018 were identified through electronic
23 and written patient records and information on timescales involved in the diagnosis and
24 management of each compiled. Descriptive statistics were used to map each step of the
25 pathway and timescales involved, with performance assessed against local departmental
26 standards and the Swansea Morriston Achilles Rupture Treatment (SMART) Protocol.
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29 **Results:** In total, 119 patients were identified, of which 113 received an ultrasound
30 examination. Local departmental standards were met in the majority of cases, with 78% (n =
31 88) diagnosed by ultrasound within one week of the request and 83% (n = 91) given a
32 treatment decision within two weeks of presentation. However this was suboptimal compared
33 with timeframes utilised for developing the SMART protocol, with only 7% (n = 8) scanned
34 within 48 hours of presentation.
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36 **Conclusions:** Key areas of the patient pathway were identified for quality service
37 improvement and redesign, with multidisciplinary discussion resulting in the development of a
38 revised patient pathway which expedites diagnosis and treatment for these injuries.
39

40 **Introduction**

41
42 Timely diagnosis and optimal management of musculoskeletal injuries has become
43 increasingly important in recent years, in view of the ageing population and increased
44 prevalence of lifestyle-related health problems that occur as a result of inactivity [1] [2]. The
45 Achilles tendon is the largest and most commonly ruptured tendon in the body and incidence
46 of its rupture has been increasing steadily since the 1980s [3]. Typically, it occurs in patients
47 aged 30-50 years old with a male to female ratio of approximately 10:1, likely due to
48 increased sports participation [4]. However, there is also a second incidence peak in the over
49 60s of low-energy injuries resulting in spontaneous rupture, secondary to chronic
50 tendinopathy [5]. There are multiple predisposing risk factors including previous Achilles
51 tendon rupture, recent steroid injection, diabetes, gout, systemic inflammatory illnesses, long
52 term dialysis, renal transplantation, smoking and the use of fluoroquinolone antibiotics [3] [4].
53 Ruptures most frequently occur in the midportion of the tendon, 2-6cm from the calcaneal
54 insertion, an area known as the "critical zone" due to its poor vascular supply predisposing it
55 to tendinosis [6]. The mechanism of injury is sudden strong activation of the posterior leg
56 muscles with the patient experiencing acute intense pain in the region of the Achilles (usually
57 described as a feeling of being kicked), often accompanied by an audible snap, and followed
58 by an inability to weight bear [3].
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3 However, despite being a commonly encountered injury, up to 20% of Achilles tendon
4 ruptures are missed by non-orthopaedic specialists [7]. This is because patients may still be
5 able to walk or plantar flex due to the contribution of the posterior tibial, peroneal and plantar
6 muscles or an intact plantaris tendon [8]. In addition, soft tissue swelling or organised
7 haematoma can hinder palpation of a tendon gap [8] [9]. Inefficiencies in the service
8 provided by Emergency, Radiology, Orthopaedic or Sports Medicine departments within the
9 National Health Service (NHS) can also contribute towards delayed diagnosis or suboptimal
10 management, with significant implications for patient morbidity and cost to the NHS and
11 wider economy. In fact, the average cost of a litigation claim for a missed or delayed
12 diagnosis of an Achilles tendon rupture is £56,900 [9]. This is because a neglected rupture
13 can heal in a lengthened position, resulting in long term weakness due to a loss of “push off”
14 strength. In addition, if surgical management of the injury is required, failure to perform this
15 in a timely manner can negate the option of a straightforward end to end repair of the
16 tendon, instead necessitating a more complex and higher risk surgical procedure (e.g V-Y
17 advancement, fascial turn-down and/or flexor hallucis longus tendon transfer) [10]. As a
18 result, fast diagnosis and optimal management are key to minimising costs incurred by the
19 NHS and ensuring a good patient outcome and experience.

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23 Despite this, current approaches to diagnosis and management of this injury vary
24 significantly, with anecdotal evidence locally highlighting disparity in the timeframe to
25 diagnosis and definitive treatment decision. This, in combination with anecdotal evidence of
26 delays to diagnosis and management within our own service, led to the development of a
27 retrospective departmental audit to explore the current timescales for diagnosis and
28 management at our NHS trust. The aim of this audit was to identify where, if any, delays in
29 the patient pathway occur, with a view to quality service improvement and redesign (QSIR)
30 and the development of ideas for future research.

31 32 33 **Method**

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35 A retrospective audit was chosen to investigate the timescales involved in the existing
36 patient pathway for suspected Achilles tendon ruptures. Currently, there are no national
37 guidelines detailing expected timescales or protocols for diagnosis and managing these
38 injuries. Whilst an Achilles tendon rupture can usually be diagnosed on the basis of patient
39 history and clinical examination, an ultrasound scan (USS) is routinely requested at our NHS
40 trust to confirm the diagnosis and assess the location and extent of injury, in order to guide
41 management decisions. However, an USS of the Achilles tendon is unavailable on initial
42 presentation as referrals are accepted only from the Orthopaedic Department, following face
43 to face or virtual review of the patient. In the interim, patients are immobilised in a backslab
44 with equinus positioning and prescribed anticoagulation to minimise the risk of developing a
45 deep vein thrombosis (DVT). Following USS, patients are then reviewed by the Orthopaedic
46 Department and those diagnosed with a complete rupture of the tendon are managed using
47 the Swansea Morrison Achilles Rupture Treatment (SMART) protocol [11]. Consequently,
48 for the purposes of this audit definitive diagnosis was deemed to have occurred on
49 completion of the USS and definitive treatment decision, when Orthopaedics reviewed the
50 patient and decided on conservative or surgical management. Performance was evaluated
51 against existing local departmental standards and the SMART protocol used for injury
52 management.

- 53 - An USS should be performed within seven days of receiving the scan request
 - 54 - SMART Protocol: An USS should be performed on a semi-urgent basis (same day or
55 next working day as presentation) [11]
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- A definitive treatment decision should be reached within two weeks of initial presentation

All suspected Achilles tendon ruptures in 2018 were identified through virtual fracture clinic (VFC) records and the Computerised Radiology Information System (CRIS). Detailed information on the timescales involved in the diagnosis and management of each case were then compiled using the Emergency Department information system, CRIS and electronic and written patient records. The following data were collected for each patient:

- Date of injury
- Date of presentation
- Location of presentation
- Date of fracture clinic review
- Date USS request was written
- Date USS request was received by Radiology
- Date USS was performed
- USS diagnosis
- Date of Orthopaedic follow up with treatment decision made
- Treatment decision
- Date of operation (if performed)
- Number of patient visits to the NHS Trust to reach treatment decision

A year of data (1st Jan – 31st Dec) were collected in order to obtain a sufficient number of cases and reduce the impact of any seasonal variations in service provision. 2018 was chosen as it was the last complete year of data available on commencing the project and sufficient time had passed to ensure that all injuries had been diagnosed and treated. Both acute and chronic injuries were included as timely ultrasound is required in all cases to inform subsequent management. Once all data had been collected they were analysed using descriptive statistics to map each step of the patient pathway, and the timescales involved, up to the point of definitive treatment decision and date of surgery, if performed. Areas for QSIR were then identified.

This audit was approved by, and registered with, the Trust Clinical Audit Department (reference number: 4517). As a clinical audit, formal ethical approval was not required as no patient identifiable data were collected and no changes were made to the patient pathway. The data involved were retrospective and collected in accordance with European General Data Protection Regulations 2018 [12].

Results

Initial presentation

In 2018, 119 suspected Achilles tendon ruptures were referred for orthopaedic review following initial injury presentation. Of these, 81% (n = 96) of patients were referred by the Emergency Department (ED) or community minor injury units (MIU). The other 19% (n = 23) were referred from a variety of other locations, the most common being their general practitioner (GP) (13%, n = 15). The referral locations of the remaining eight patients included a neighbouring NHS trust, other hospital departments (Physiotherapy, Podiatry and Rheumatology), self-referral and private practice.

The vast majority of these patients (86%, n = 102) presented with an acute injury, defined as one which occurred within the preceding two weeks, as per the American Academy of Orthopaedic Surgeon guidelines (2009) [13]. The timeframe between injury and initial presentation for the remaining 14% (n = 17) of patients ranged from 15 days to six months.

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3 Of these, two patients (1.7%) were originally discharged and re-presented later to their GP.
4 However, whilst this added 18-30 days onto their patient pathway it is worth noting that
5 neither were subsequently diagnosed with a rupture of their Achilles tendon, with one later
6 diagnosed as a partial thickness tear and the other a torn accessory soleus muscle.
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8 **Initial Orthopaedic Review**

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10 The standard pathway for patients following initial presentation is referral to VFC for
11 orthopaedic review and this operates daily Monday to Friday each week. In 2018 this
12 occurred for 89% of patients (n = 106) with the number of actual days (as opposed to
13 working days) between referral and review ranging from 1 to 11, with 66% (n = 70) reviewed
14 within two days. However, all patients who presented to ED or MIU were reviewed in VFC
15 within five days. The remaining 11% of patients (n = 13) presented via an atypical referral
16 route, resulting in a face to face review. Notably the majority of these 13 were chronic
17 injuries (54%, n = 7).
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19 **USS Request**

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21 Following Orthopaedic review, a paper USS request form was completed. From the dates
22 written on the form, this occurred anywhere between 0-11 days following VFC review and 0-
23 7 days following face to face review. However, 80% (n = 95) were written on or before the
24 Orthopaedic review, 10%, (n = 12) within a week of review and 4% (n = 5) within two weeks.
25 For the remaining 6% (n = 7) this could not be calculated as no date was provided on the
26 request form. Radiology then received the request form 0-5 days post completion, with 90%
27 (n = 107) received the day they were written.
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30 **USS**

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32 The USS was then performed 0-47 days following receipt of the request form (Figure 1). A
33 total of 113 of the 119 patients received a scan within the ultrasound department with the
34 remaining six patients (5%) seen at other NHS trusts or privately. All ultrasound scans
35 performed within the trust were undertaken by a consultant MSK radiologist or clinical
36 specialist MSK sonographer. The gap between the tendon ends was assessed in the
37 following positions; 20-30 degrees plantar flexion, full plantar flexion, and full plantar flexion
38 with 20 degrees of knee flexion, as per the SMART protocol [11].
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41 Of the total number scanned 88% (n = 78) received their USS within seven days of
42 Radiology receiving the request form, as per the current departmental standard. Only 18%
43 (n = 20) received an USS on the same day as the request was received or next working day.
44 When readjusted to take into account date of initial injury presentation, this number reduced
45 further, with only 7% (n = 8) receiving an USS the same day, or next working day, as per the
46 SMART protocol (Figure 2) [11].
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48 **USS diagnosis**

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50 Of the 113 patients scanned, 66% (n = 75) were diagnosed with a rupture of the Achilles
51 tendon and 16% (n = 18) with a partial thickness tear (see Figure 3). The remaining 18% (n
52 = 20) received a variety of diagnoses with 60% (n = 12) discharged, 35% (n = 7) requiring
53 conservative treatment (vacoped boot and anticoagulation) and 5% (n = 1) requiring
54 physiotherapy only.
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58 Total timeframe from first presentation to USS diagnosis was calculated for each patient and
59 ranged from same day as initial presentation to up to 76 days later with 60 patients (53%)
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3 diagnosed within a week and 101 patients (89%) within two weeks (Figure 4). For the
4 patients who were discharged without a tendon tear, USS diagnosis occurred between three
5 and 54 days post initial presentation.
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7 The majority (85%, n = 64) of the complete ruptures diagnosed were acute injuries and 97%
8 of these (n = 62) presented within one week of injury, with 44% (n = 28) presenting the same
9 day as their injury.
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11 **Definitive treatment decision**

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13 Following USS the patient received an orthopaedic review to decide on treatment approach.
14 Only 23% of the patients scanned (n = 26) were reviewed by Orthopaedics on the same day
15 as their ultrasound scan (Figure 5).
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17 Total timeframe from initial presentation to definitive treatment decision ranged from same
18 day as presentation to up to 96 days later (Figure 6). However, the majority of patients
19 (83%, n = 91) did receive a treatment decision within two weeks of initial presentation. In
20 order to obtain this decision, patients attended the trust between one and five times, with
21 three visits required on average.
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23 The majority of patients with a complete rupture were treated conservatively with only 19
24 (25%) requiring surgical management. All operations were performed within 24 days of
25 presentation, with 79% (n = 15) operated on within two weeks.
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27 **DISCUSSION**

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29 Completion of this audit highlighted a number of key areas of the existing patient pathway
30 suitable for QSIR. Firstly, the data demonstrated that 100% of complete ruptures of the
31 Achilles tendon which presented in 2018 to ED and MIUs at our trust were correctly
32 diagnosed and referred to VFC. Only one partial thickness tendon tear was originally
33 discharged from ED, demonstrating a high sensitivity for emergency clinicians and nurse
34 practitioners diagnosing these injuries. This concurs with existing literature that the majority
35 of these injuries can be diagnosed on patient history and clinical assessment alone [3], and
36 contradicts previous research which found that 20% of ruptures may be missed by non-
37 orthopaedic specialists [7]. This suggests that ED clinicians and practitioners do possess
38 expertise for assessment of these injuries and should not be considered “non-specialists”.
39 The fact that one partial thickness tear was initially discharged is unsurprising as these are
40 known to be more problematic to diagnose clinically, with symptoms easily misinterpreted as
41 aggravated Achilles tendinopathy [14]. Unfortunately, it was beyond the audit scope to
42 determine if any of the patients who initially presented via other referral routes had their
43 initial referral delayed for any reason. However, the fact that referrals were received via
44 these routes, indicated that current NICE guidelines were not always being followed in
45 primary care, as same day ED assessment for patients presenting with a suspected tendon
46 rupture is advised [15]. Further research may help to elucidate the reasons for this and
47 ascertain the need for any further education in primary care on the necessity for expedited
48 diagnosis and management of these injuries.
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53 Conversely, specificity for clinically diagnosing an Achilles tendon rupture was slightly lower
54 at 82%, with 20 patients found to have normal appearances or alternative pathology on USS.
55 This illustrates the need for expedited USS following presentation, in order to avoid
56 unnecessarily prolonged immobilisation and anticoagulation. Had direct access to USS
57 been available in 2018, 11.5% of the patients scanned (n = 13) would not have required this,
58 reducing the risks to the patient and costs to the Trust. The existing requirement for
59 Orthopaedic review prior to USS resulted in a lengthened pathway with additional patient
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4 consultations. All orthopaedic injuries were placed on the same initial pathway, regardless
5 of whether they were bone or soft tissue related, to ensure that all were reviewed and
6 managed by an Orthopaedic specialist, ideally via VFC. This works well for bone injuries, as
7 plain radiographs can be reviewed in VFC within a target of 72 hours and the diagnosis
8 confirmed, often with little change to initial management [16]. However, this audit
9 demonstrates it is less effective for soft tissue injuries, in part hampered by the inability for
10 ED to request an USS. Additionally, further delays occurred due to the use of paper-based
11 USS referrals. However, since completing this audit, the Radiology department has begun
12 the transition to electronic requesting and this should negate these issues for future cases.
13 The transition to remote electronic imaging requesting has been long advocated by the
14 Royal College of Radiologists as it is recognised that the use of information technology can
15 greatly improve departmental efficiency and the patient experience [17], and these audit
16 results provide an effective example of the inefficiency of a paper based referral system.
17 Furthermore, following clinician engagement and consultation, the electronic requesting
18 system has now been updated to enable ED clinicians to request an USS for suspected
19 Achilles tendon rupture and a non-medical referrer delegation set up for Emergency Nurse
20 Practitioners working in ED and MIUs.
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24 This audit also demonstrated that the existing departmental target of undertaking an USS for
25 a suspected Achilles tendon rupture within seven days of receiving the referral was achieved
26 in 78% of cases. Due to the retrospective method it was not possible to ascertain the
27 reasons why this was not achieved for the remaining cases, although it is thought that this
28 was most likely due to staff shortages limiting USS capacity. Despite this result, it could be
29 argued that a more appropriate local standard would be to scan these patients on a semi-
30 urgent basis (i.e. same day as presentation or the next working day) in line with the SMART
31 protocol given it is used as a the basis for injury management [11]. Figure 2c models how
32 often this would have been achieved in 2018 if this were the accepted standard; only 7% of
33 cases. This has clinical significance as the gastrocnemius/soleus complex retracts over time
34 post injury, increasing the size of the gap between tendon ends [18]. This potentially
35 increases the requirement for surgical treatment as this is recommended by the SMART
36 protocol for patients with a tendon gap of more than 1cm in maximum equinus, assuming no
37 surgical contraindications [11]. However, it is also possible that a deliberate delay between
38 injury and USS could actually result in a more accurate assessment of the tendon gap size,
39 as the retraction process can occur and settle, with research indicating this process may
40 take three to four days post injury [18]. As a result, further research would be useful to
41 determine how tendon gap size changes over time post injury with a view to determining the
42 optimal time to perform an USS and decide on a treatment approach.
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46 In the absence of further evidence, a pragmatic decision was taken to update the pathway in
47 order to complement the existing SMART protocol with a new departmental standard
48 implemented; an ultrasound scan for a suspected Achilles tendon rupture should be
49 performed the same day as presentation, or the next working day. With the implementation
50 of electronic USS requesting via ED this is now possible and brings the department in line
51 with the standards used in the development of the SMART protocol [11]. To facilitate this,
52 USS workforce capacity has been redesigned to provide daily outpatient musculoskeletal
53 lists with dedicated slots available for these patients five days per week (Monday to Friday),
54 something which was unavailable in 2018. This will not only improve timeframe to diagnosis
55 but also the patient experience with the aim being to facilitate prompt commencement of
56 treatment. Early weight bearing and mobilisation has been shown to have a positive impact
57 on patient outcomes and reduce risk of developing a DVT and should ideally commence two
58 weeks post injury for conservative management [3] [11]. Yet in 2018 not all patients had a
59 definitive diagnosis or treatment decision two weeks post presentation.
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5 Expedited diagnosis is of limited benefit without corresponding expedited clinical
6 management decisions. Consequently, additional same day Orthopaedic review, which only
7 occurred for 23% of patients in 2018, has now been introduced. Whilst the majority of
8 patients (83%, n = 91) did still receive a treatment decision within two weeks of presentation
9 in line with departmental standards, this required multiple hospital visits impacting both the
10 individual (cost, uncertainty/delay regarding treatment and potentially prolonged
11 immobilisation/anticoagulation) and the trust (cost, time and increased administration).
12 Patients will now have Orthopaedic review immediately following their USS, in order to allow
13 the standard to be achieved for all patients and improve the patient experience. The
14 development of dedicated ultrasound appointments has made this possible, allowing
15 capacity across the departments to be linked, illustrating the importance of effective
16 communication between departments of differing clinical specialties when redesigning
17 patient pathways. This will also aid maintenance of the existing performance for operating
18 on those who require surgical management in a timely manner, as evidenced by the fact
19 80% of these patients underwent their procedure within two weeks of presentation in 2018,
20 negating the need for more complex and expensive surgical procedures. Furthermore, it
21 could introduce the possibility of earlier surgery, facilitating less invasive or percutaneous
22 techniques that are associated with fewer soft tissue complications [19].
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28 **CONCLUSION**

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30 This audit provided objective, quantitative data to support anecdotal concerns regarding
31 existing service provision for Achilles tendon injury. It provided an overview of the patient
32 pathway as a whole and led to the identification of several key areas for QSIR. The
33 subsequent interdepartmental, multidisciplinary discussion involving Emergency, Radiology
34 and Orthopaedic departments resulted in a revised, streamlined patient pathway with
35 improvements to USS access and same day Orthopaedic review. It is anticipated that this
36 updated patient pathway will not only improve patient outcomes and their overall experience
37 but will also benefit the trust with fewer appointments and reduced costs. This audit has also
38 identified the disparity in practice across the NHS and identified areas for further research
39 which may help to inform future practice and assist in the development of national
40 guidelines. Ultimately though, this project illustrates the importance of effective
41 interdepartmental, multidisciplinary communication when undertaking large audits, and the
42 need to assess a patient pathway in its entirety when undertaking QSIR in order to have the
43 greatest impact. Re-audit of this pathway is planned for one year post implementation in
44 order to assess the effectiveness of the changes implemented.
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Figure 1: Time to USS following receipt of request.

Figure 2: A) Number of USS performed within seven days of receiving the request (current local standard); B) Number of USS performed on the same day request was received or next working day; C) Number of scans performed on the same day as initial injury presentation or next working day (as per SMART protocol) [11].

Figure 3: USS diagnoses of the 113 patients scanned.

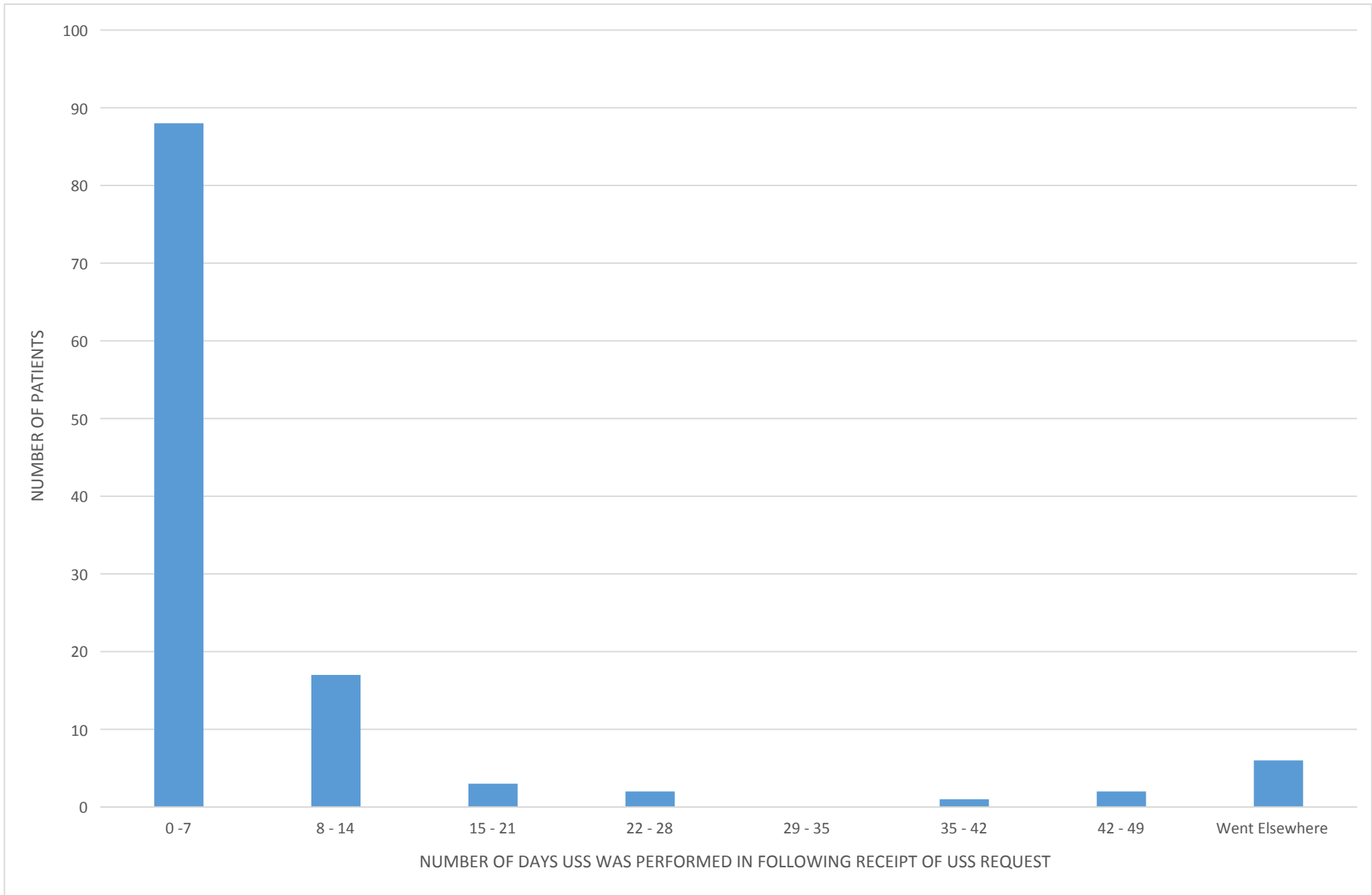
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Figure 4: Number of days from first trust presentation to USS diagnosis for the 113 patients scanned.

Figure 5: Number of days between USS and orthopaedic review

Figure 6: Number of days between first trust presentation and definitive treatment decision for the 113 patients scanned.

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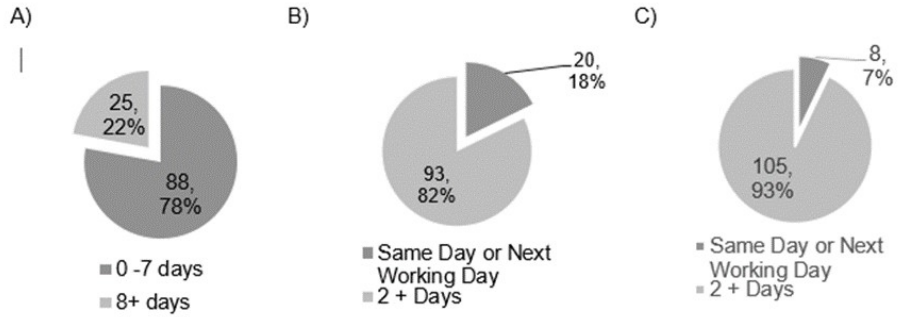
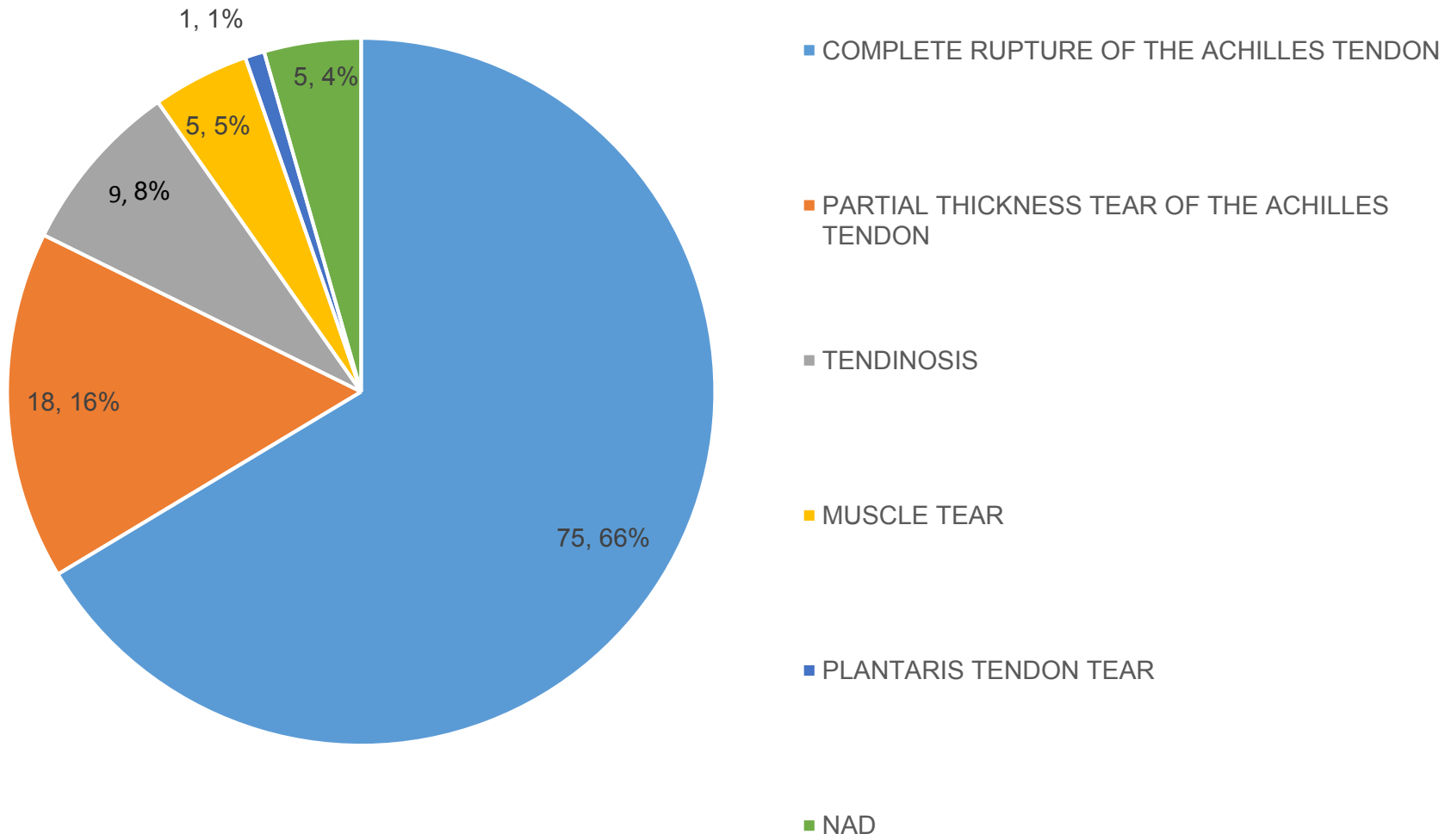


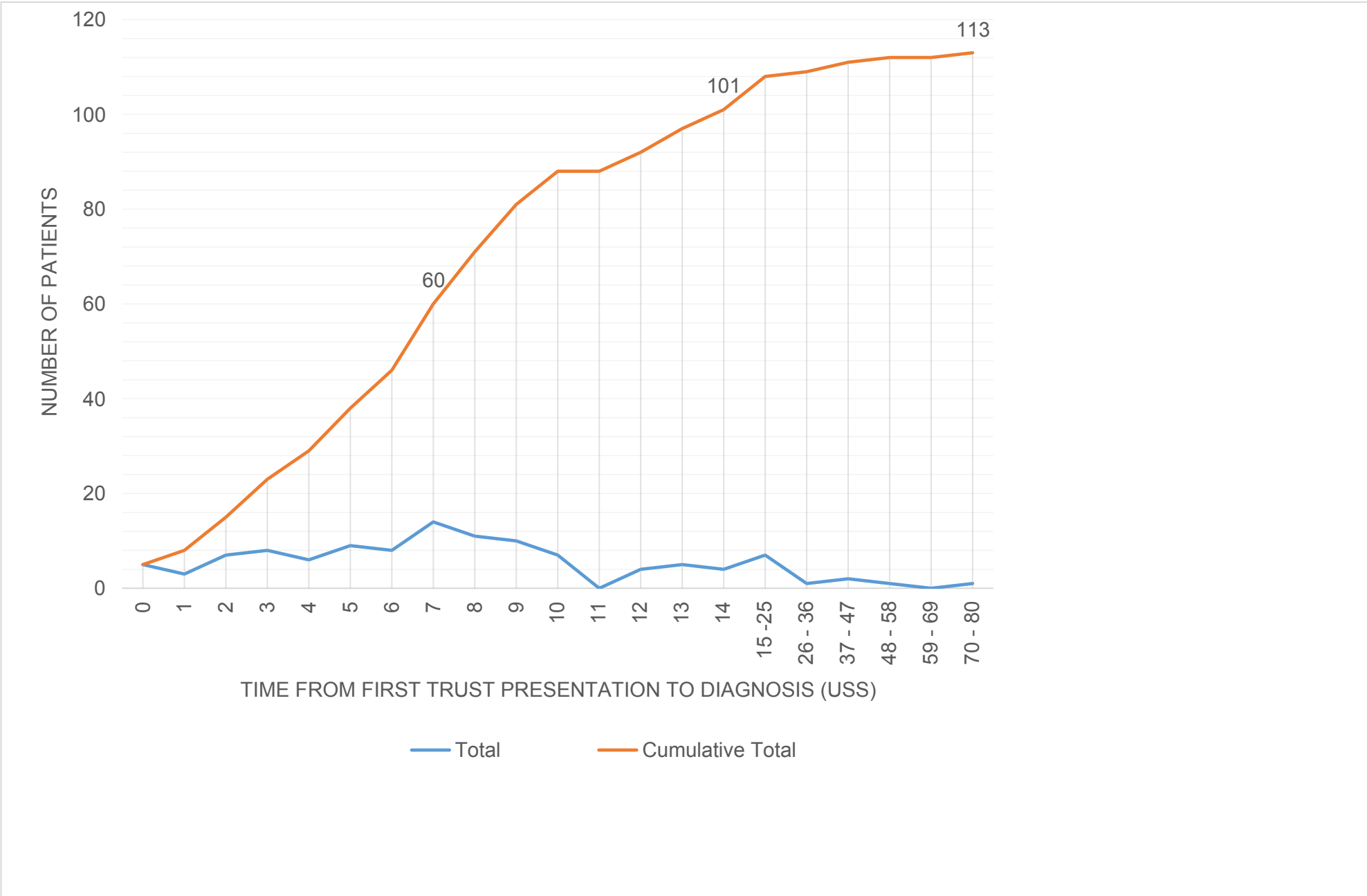
Figure 2: A) Number of USS performed within 7 days of receiving an USS request (current local standard); B) Number of USS performed on the same day USS request was received or next working day; C) Number of USS performed on the same day as initial presentation or next working day (as per SMART protocol [10]).

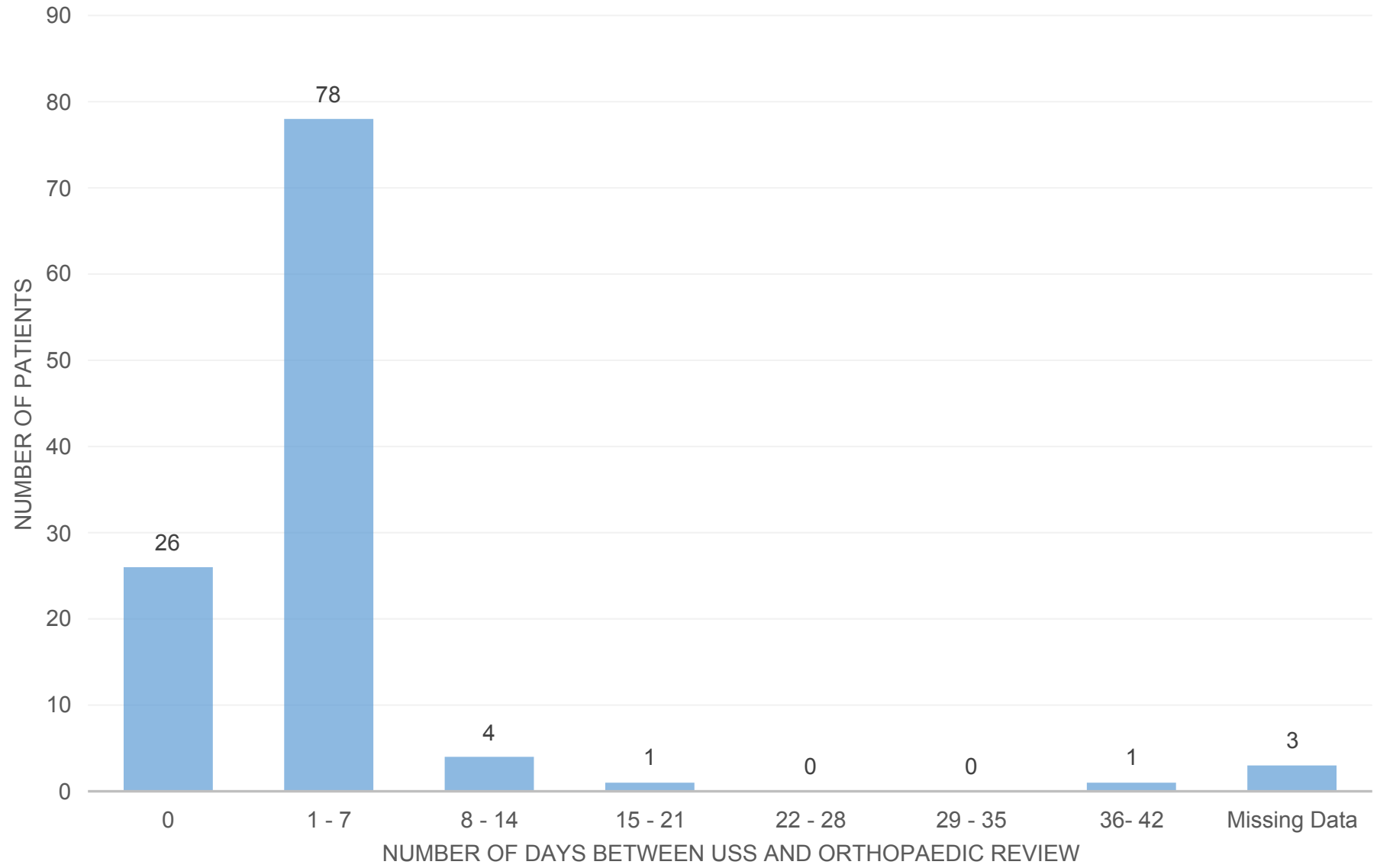
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