Imaging of Intimate Partner Violence, From the *AJR* Special Series on Emergency Radiology

Anji Tang, MD[1,2], Andrew Wong, MD, PhD[1], Bharti Khurana, MD[1,2]

Multispecialty · Special Series Review

Keywords

artificial intelligence, COVID-19, emergency radiology, intimate partner violence

Submitted: May 9, 2022
Revision requested: May 20, 2022
Revision received: Aug 9, 2022
Accepted: Aug 30, 2022
First published online: Sep 7, 2022
Version of record: Jan 25, 2023

The authors declare that there are no disclosures relevant to the subject matter of this article.

Intimate partner violence (IPV) is a highly prevalent public health issue with multiple adverse health effects. Radiologists are well suited to assessing a patient's likelihood of IPV. Recognition of common IPV injury mechanisms and resulting target and defensive injury patterns on imaging and understanding of differences between patients who have experienced IPV and those who have not with respect to use of imaging will aid radiologists in accurate IPV diagnosis. Target injuries often involve the face and neck as a result of blunt trauma or strangulation; defensive injuries often involve an extremity. Awareness of differences in injury patterns resulting from IPV-related and accidental trauma can aid radiologists in detecting a mismatch between the provided clinical history and imaging findings to support suspicion of IPV. Radiologists should consider all available current and prior imaging in assessing the likelihood of IPV; this process may be aided by machine learning methods. Even if correctly suspecting IPV on the basis of imaging, radiologists face challenges in acting on that suspicion, including appropriately documenting the findings, without compromising the patient's confidentiality and safety. However, through a multidisciplinary approach with appropriate support mechanisms, radiologists may serve as effective frontline physicians for raising suspicion of IPV.

The CDC definition of intimate partner violence (IPV) centers on physical or sexual violence by a current or former partner [1]. The true extent of IPV is not known, but the global prevalence of IPV against women in heterosexual relationships is estimated to be 26% [2] with prevalence as high as 71% in some countries [3]. Recognition of IPV in same-sex, transgender, and queer intimate relationships and against men in heterosexual relationships is increasing. Although data on these groups are less robust, ongoing research efforts have shown that IPV affects persons regardless of gender or type of intimate relationship [4].

In the United States, the 2010–2012 state report resulting from the National Intimate Partner and Sexual Violence Survey (NISVS) estimated that over one in three women experience physical or sexual violence or stalking by an intimate partner in their lifetime [5]. In addition, although women experience IPV more frequently than men, 28.3% of men surveyed in the NISVS reported physical violence by an intimate partner during their lifetime [5, 6]. However, the NISVS findings likely underestimate the extent of IPV in the United States. Persons in relationships with a violent partner or who had recently experienced violence may have been hesitant to complete the survey because of fear of retaliation. In addition, NISVS data were gathered in random-dial telephone calls, potentially excluding people living in nursing homes, military bases, prisons, or shelters and those without housing [7].

During the COVID-19 pandemic, measures taken to reduce the spread of infection, such as lockdowns and social distancing, exacerbated domestic violence toward women and children [8]. During that time, the number of people seeking hospital care after IPV decreased despite increases in the incidence and severity of physical abuse [9]. Such findings suggest a reluctance during the pandemic to seek care at early stages of the abuse cycle.

If not detected in a timely manner, IPV can cause myriad downstream adverse effects, including chronic psychosomatic disorders, pregnancy complications, and traumatic brain injuries [4]. IPV is often deadly if action is not taken. In 2017, 58% of intentionally killed women were murdered by an intimate partner or family member [10].

ARRS is accredited by the Accreditation Council for Continuing Medical Education (ACCME) to provide continuing medical education activities for physicians.

The ARRS designates this journal-based CME activity for a maximum of 1.00 AMA PRA Category 1 Credit™. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

To access the article for credit, follow the prompts associated with the online version of this article.

doi.org/10.2214/AJR.22.27973

AJR 2023; 220:476–485

ISSN-L 0361–803X/23/2204–476

© American Roentgen Ray Society

[1]Department of Radiology, Brigham and Women's Hospital and Harvard Medical School, 75 Francis St, Boston, MA 02115. Address correspondence to B. Khurana (bkhurana@bwh.harvard.edu).

[2]Trauma Imaging Research and Innovation Center, Brigham and Women's Health, Boston, MA.

Downloaded from www.ajronline.org by 88.24.148.67 on 02/13/25 from IP address 88.24.148.67. Copyright ARRS. For personal use only; all rights reserved

Downloaded from www.ajronline.org by 88.24.148.67 on 02/13/25 from IP address 88.24.148.67. Copyright ARRS. For personal use only; all rights reserved

There is a clear urgency to identify persons experiencing IPV who might otherwise go unrecognized. Radiologists have a duty to help ensure that patients presenting for health care do not have their injuries mislabeled as routine accidental trauma and that appropriate discussions about the possibility of IPV are broached and resources offered to those in need.

Screening for Potential Intimate Partner Violence by Physicians in Health Care Settings

The U.S. Preventive Services Task Force recommends screening all women of childbearing age for IPV [6]. Such screening typically occurs at physician offices and other health care settings. A randomized controlled trial showed that a self-completed IPV screen of adult female patients presenting to a universal health care clinical setting yielded benefit without associated short-term harm [11].

Family physicians have been at the forefront of screening for IPV through the use of surveys such as the Woman Abuse Screening Tool, which includes questions such as whether "arguments ever result in hitting, kicking, or pushing" [12]. Obstetricians and gynecologists may also play an active role in screening, especially during pregnancy [4]. The Slapped, Threatened, and Throw and the Hurt, Insult, Threaten, Scream questionnaires are additional screening tools that may be administered by physicians or self-administered [6]. A primary limitation of screening tools is that patients may not be forthcoming [6]. Patients may be influenced by cultural and societal stigmas that lead them to fear discrimination and devaluation should their IPV status be revealed [13].

The emergency department (ED) is a useful setting for IPV detection because it is available at all times and is a common site of care for injuries caused by IPV [14]. George et al. [15] found that nearly one-half of patients treated in the ED after incidents of IPV presented with symptoms that did not directly result from the violence, yet 84% eventually reported physical violence, and 82% disclosed at least one episode of violence before the index visit. Yet, a large percentage of IPV diagnoses are regularly missed in EDs. One estimate is that at least 54% of female patients in the ED have experienced IPV during their lifetime, yet only 5% are identified as such [14]. An additional study showed that women with positive results of IPV screening in the ED are likely to experience additional IPV in the subsequent 4 months [16]. However, ED physicians face barriers to IPV detection [17]. For example, EDs are frequently overcrowded, and ED physicians may be limited in time and preparedness to address IPV [14].

Imaging departments may also perform IPV screening. The patient is typically alone at some point during an imaging examination. For example, the partner or caregiver generally exits the scanning room during CT because of radiation concern and does not enter the room during MRI for various safety reasons. Thus, the imaging technologist has an opportunity to screen the patient in isolation. Informational signs and pamphlets regarding IPV may be placed in changing rooms and may also help overcome barriers.

Nearly two-thirds of women with a history of IPV undergo screening mammography, highlighting the potential for breast imaging centers in particular to serve as screening locations [18]. According to answers on an intake questionnaire in one study, 71 women among 68,158 patients presenting to outpatient breast imaging centers for screening and diagnostic mammography over an 18-month period were identified as feeling unsafe at home [19]. Women presenting for their first mammogram were more likely to report feeling unsafe, suggesting benefit from extra vigilance in this population [19].

HIGHLIGHTS

- *Radiologists are well suited to detecting potential intimate partner violence (IPV) on the basis of a comprehensive assessment of all available current and prior imaging examinations.*
- *Specific imaging patterns seen in IPV include target injuries to the face, neck, torso, and axial skeleton and defensive injuries to the appendicular skeleton.*
- *Radiologists face dilemmas when deciding how to communicate suspicion of IPV to the ordering clinician without compromising the patient's confidentiality and safety.*

Role of Radiologists in Detecting Intimate Partner Violence

Radiologists are mandated by law to be trained in detecting violent injuries in children and often play a critical role in detecting child abuse. Radiologists can accordingly be held liable if a child returns to an unsafe home and experiences further injuries as a result of failure to diagnose nonaccidental trauma [20]. Radiologists are also well suited to detect IPV, applying multiple diagnostic clues to detect such injuries. A thorough understanding of the injury patterns that result from various traumatic mechanisms, recognition of prior injuries involving different body parts, identification of inconsistencies in the patient's clinical history, and discerning a history of high imaging utilization may all support a radiologist's suspicion of IPV [21] (Fig. 1). Furthermore, the lack of face-to-face contact with patients during routine image interpretation could lessen certain subconscious biases and other hesitancies about raising suspicion of IPV [22]. In addition, radiologists may notice subtle findings or stigmata of previous injuries that are occult at physical examination. For instance, persons

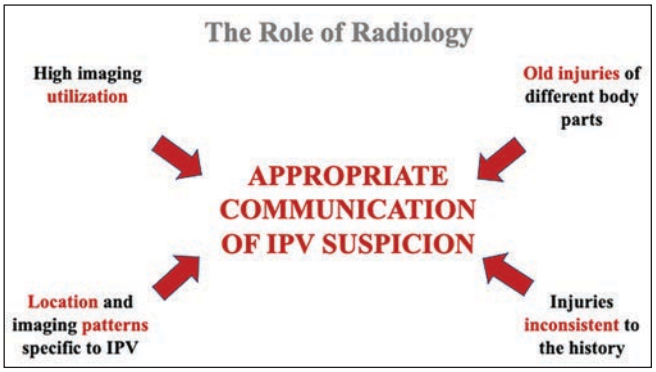


Fig. 1—Chart shows role of radiologists in assessing and communicating likelihood of intimate partner violence (IPV) on basis of diagnostic clues on imaging examinations. (Adapted from [21], with permission)

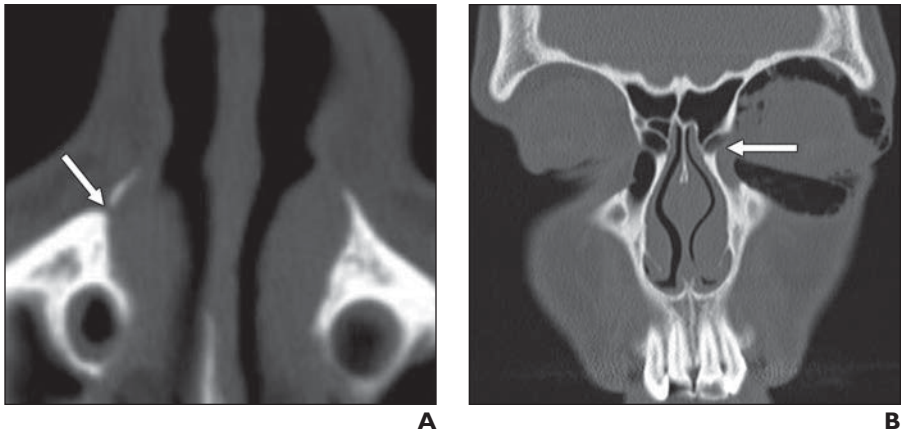


Fig. 2—Facial injuries from intimate partner violence.
A, 24-year-old woman with head trauma. Axial CT image of head shows minimally displaced fracture (*arrow*) of right nasal bone.
B, 32-year-old woman with left eye injury. Coronal CT image of face shows minimally displaced fracture (*arrow*) of left lamina papyracea with postseptal extension of preseptal gas into superior and inferior orbit.

subjected to nonfatal strangulation may not display overt injuries at physical examination yet have neurologic symptoms, such as headaches and amnesia, which could have correlative findings on craniofacial CT and CTA [21]. Subtle findings such as chronic nasal fractures (Fig. 2A) may also be seen only on imaging and lack a physical examination correlate.

Imaging Patterns Specific to Intimate Partner Violence

Injury patterns specific to IPV fall under two broad categories: injuries resulting from targeted assault and defensive injuries. Target injuries include the face, neck, torso, and axial skeleton; defensive injuries typically involve the appendicular skeleton.

Target Injuries

In a study of 1.65 million ED visits for IPV collected as part of the National Electronic Injury Surveillance System–All Injury Program (NEISS-AIP), 48% of fractures involved the face [23]. In an additional study of patients treated for domestic violence, the face was the most commonly injured anatomic region. Facial injuries were found in 81% of patients, and 50% presented with an isolated maxillofacial injury [24]. In that study, the most common means of assault were the fist (67%) and weapons (15%), most of which were blunt objects such as pipes or bottles [24]. In a study of persons experiencing IPV who were hospitalized after presenting to level I trauma centers, injuries found on imaging most commonly involved the head or face and most commonly were due to blunt trauma [25]. Moreover, in a study of patients with traumatic facial injuries, 68% of patients had injury involving the midface, which was the most frequent site of injury [26]. The most commonly fractured sites were, in order, the nasal bones, mandible, and orbits. This finding may be explained by the ease of targeting the nose with a fist or blunt object [26]. Injuries more commonly involved the left than the right side of the face, likely reflecting the right-handed dominance of the general population [26]. These results support raising suspicion of IPV when maxillofacial injuries, especially of the midface, are found (Fig. 2B).

TABLE 1: Common Intimate Partner Violence–Related Injuries by Anatomic Region

Region	Injury
Maxillofacial region [26]	Midface and periorbital region (most common sites) Left-sided injuries (most common laterality) Soft-tissue swelling Nasal, mandibular, and orbital fractures (in order of frequency)
Upper extremity	Nondisplaced and noncomminuted fractures Ulnar shaft fractures [34] Medial hand fractures [33] Finger fractures [33, 37] Shoulder fractures [37]
Lower extremity [48]	Foot Ankle
Torso (chest and abdomen)	Rib, sternal, and clavicular fractures [32] Pneumothorax, hemothorax, and pneumomediastinum [32] Penetrating injuries due to stab wounds [25]
Spine [49]	Upper lumbar spine (most common level)
Multiple regions	Both facial (target) and upper extremity (defensive) injuries [26] Acute and chronic injuries [15] Recurrent injuries of mild severity [50] High imaging utilization with disproportionate volume of imaging studies in the emergency department and cancellation of screening studies [34]

Downloaded from www.ajronline.org by 88.24.148.67 on 02/13/25 from IP address 88.24.148.67. Copyright ARRS. For personal use only; all rights reserved

Craniofacial injuries are closely related to traumatic brain injuries (TBI) and hypoxic strangulation injuries. MRI may provide insight into the long-term effects of such injuries. Whole-brain MRI analyses have shown structural differences between female patients who have and those who have not experienced IPV. For example, in one study, brain region volumes were greater among persons who had not experienced IPV than among those who had, even after control for non–IPV-related TBI, age, and substance use [27]. In that study, strangulation attempts were negatively correlated with cortical thickness in the horizontal ramus of the anterior segment of the lateral sulcus. A challenge in assessing TBI on MRI is differentiation of atrophy and white matter changes due to trauma from those resulting from nontraumatic causes, such as diabetes, hypertension, and substance use. Advanced MRI may assist in this task. For example, in a study of women with mild TBI, fractional anisotropy (derived from diffusion-tensor imaging) in the posterior and superior corona radiata and posterior thalamic radiation was significantly associated with the number and recency of episodes of IPV-related mild TBI [28]. Although the clinical implications of this finding remain unclear, the finding highlights the potential impact on the brain's microstructure of the mild TBI that may result from IPV.

Patients who experience nonfatal strangulation may have CTA evidence of cervical vascular injury. In one case series, three women who experienced prior manual strangulation by their spouses all had bilateral internal carotid artery dissections and sequelae of healed dissections (e.g., stenoses and occlusions) [29]. Internal carotid artery dissection poses major risk for cerebral infarction, and timely identification is crucial. In the case series, two of the three women had delayed strokes requiring percutaneous angioplasty, and the third woman experienced continued neurologic impairment due to ischemic watershed strokes that precluded percutaneous therapy. CTA can also depict subtle nonvascular injuries, such as small tracheal perforations [30] and laryngeal cartilage fracture [31]. Given the anatomic coverage of the examination, facial fractures (e.g., to the orbit or zygomatic arch) may also be detected with CTA.

IPV may target anatomic regions other than the face and neck (Fig. 3). For example, Sun et al. [25] observed a spectrum of thoracic injuries—including rib fractures, pneumothorax, and diaphragmatic injury—among patients hospitalized after IPV who had presented to the ED at level I trauma centers (Fig. 4). Injuries to the abdominal viscera and lumbar spine were also found [25]. Gosangi et al. [32] reported that in patients with IPV-related thoracic injuries, the predominant injuries included fractures of the ribs, sternum, and clavicle. Less frequent yet more severe injuries included pneumothorax, pneumomediastinum, and hemothorax. Gosangi et al. [9] also reported a higher incidence of thoracic and abdominal injuries and higher injury severity during the early weeks of the COVID-19 pandemic. George et al. [15] observed significantly high-

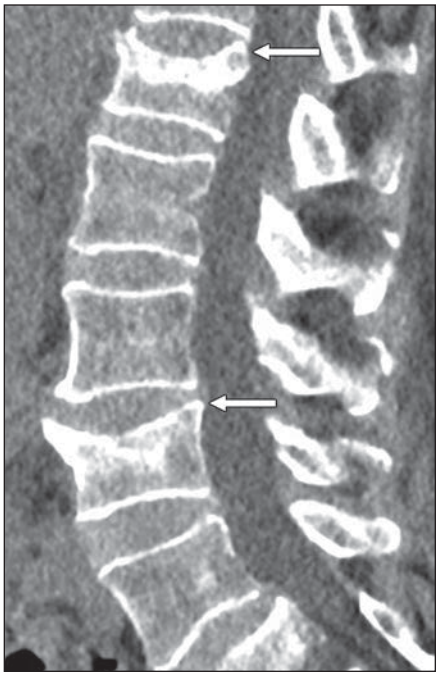


Fig. 3—62-year-old woman who presented to emergency department 2 weeks after fall. Sagittal CT image of lumbar spine shows superior endplate compression deformities (*arrows*) of L1 and L4.

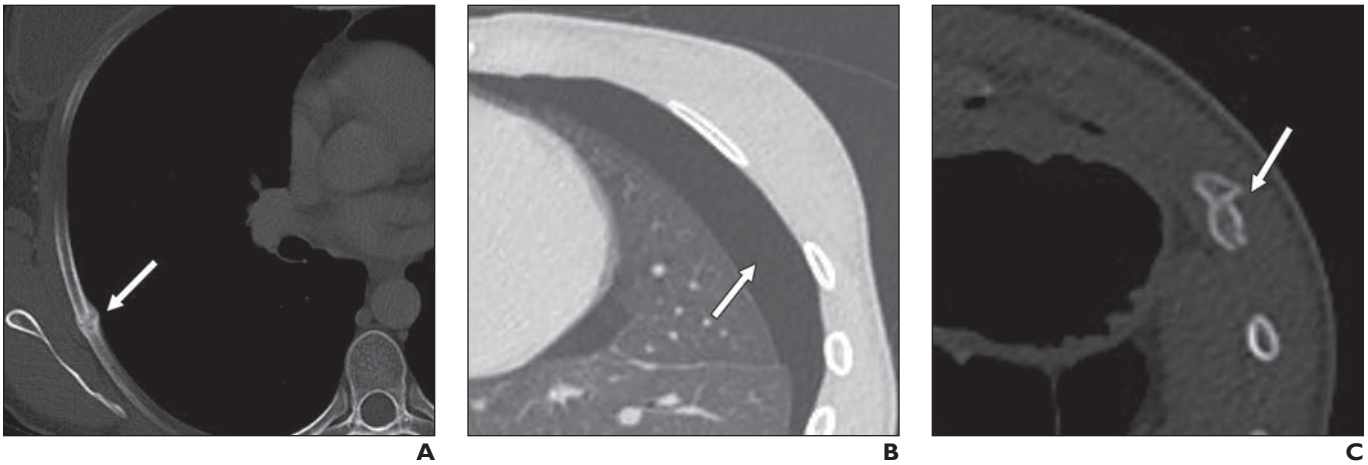


Fig. 4—Chest injuries from intimate partner violence.
A, 41-year-old woman with chest pain. Axial CT image of chest shows healing subacute fracture (*arrow*) of right lateral aspect of sixth rib. Patient later disclosed intimate partner violence.
B and **C,** 28-year-old woman pushed into furniture by partner. Axial CT images of chest show left pneumothorax (*arrow*, **B**) and mildly displaced left seventh rib fracture (*arrow*, **C**).

Downloaded from www.ajronline.org by 88.24.148.67 on 02/13/25 from IP address 88.24.148.67. Copyright ARRS. For personal use only; all rights reserved

er frequencies of obstetric complications (e.g., subchorionic hematoma and intrauterine growth restriction) in women who had experienced IPV than in control individuals. Table 1 summarizes the most common IPV-related injuries stratified by anatomic region.

Defensive Injuries

IPV-related extremity fractures are common. In a study of female survivors of IPV referred to the Minnesota Domestic Abuse Project, musculoskeletal injuries were the second most common category of IPV-related trauma after head-and-neck injuries [33]. Data from the NEISS-AIP showed that the odds of fracture after IPV injuries to the upper and lower extremities were 6.6 and 6.5 times the odds of injuries to the lower trunk [23]. Figures 5 and 6 show examples of upper and lower extremity IPV-related fractures. The odds of fracture also increased with increasing age, but patients older than 65 years were excluded from the analysis.

Because IPV frequently involves individuals defending themselves from an attacker, extremity fractures commonly represent defensive injuries. Thomas et al. [34] noted that 26% of upper extremity fractures involved the medial hand and fingers, suggestive of defensive posturing. Moreover, fractures most commonly involved the finger (46% of all fractures), suggestive of altercation (Fig. 7). Ulnar fractures are also classically categorized as defensive injuries, sustained as a person raises the arm to protect the face or central body. In one study, Khurana et al. [35] concluded that isolated ulnar fractures may be the result of IPV in as many as one-third of women. Furthermore, because IPV rarely occurs as a single episode, imaging may show multiple prior extremity injuries. Thomas et al. [34] found that one of the most common injuries to occur after an initial upper extremity injury was a second upper extremity injury. In that study, in 50% of patients with recurrent upper extremity trauma, the subsequent injury was to the same hand. Extremity injuries also commonly accompany other injuries. For example, Gujrathi et al. [26] noted that among patients with facial injuries, the most commonly associated injuries were upper extremity injuries, occurring synchronously in 11.4% of patients and preceding the index facial injury in 21% of patients.

Acute and Chronic Injuries

George et al. [15] found chronic extremity and nasal fractures to be significantly more frequent among patients experiencing IPV than among matched control individuals. Chronic fractures may be the only finding of IPV when there is a delay between the time of assault and presentation for clinical care [22]. Moreover, the presence of synchronous acute and chronic injuries is highly specific for IPV. One study showed chronic fractures and simultaneous chronic and recent fractures to be significantly more frequent in women who experienced IPV than in women who experienced stranger assaults; chronic fractures had 97.6% and simultaneous chronic and recent fractures had 99.2% specificity for IPV. Simultaneous chronic and recent fractures were also significantly associated with IPV in multivariable analyses [34]. To assess the chronicity of injuries, radiologists should search for prior trauma-related imaging studies in the PACS or electronic medical record.

Inconsistencies Between Clinical History and Radiologic Findings

Radiologists may identify mismatches between the provided clinical history and objective imaging findings that suggest an alter-

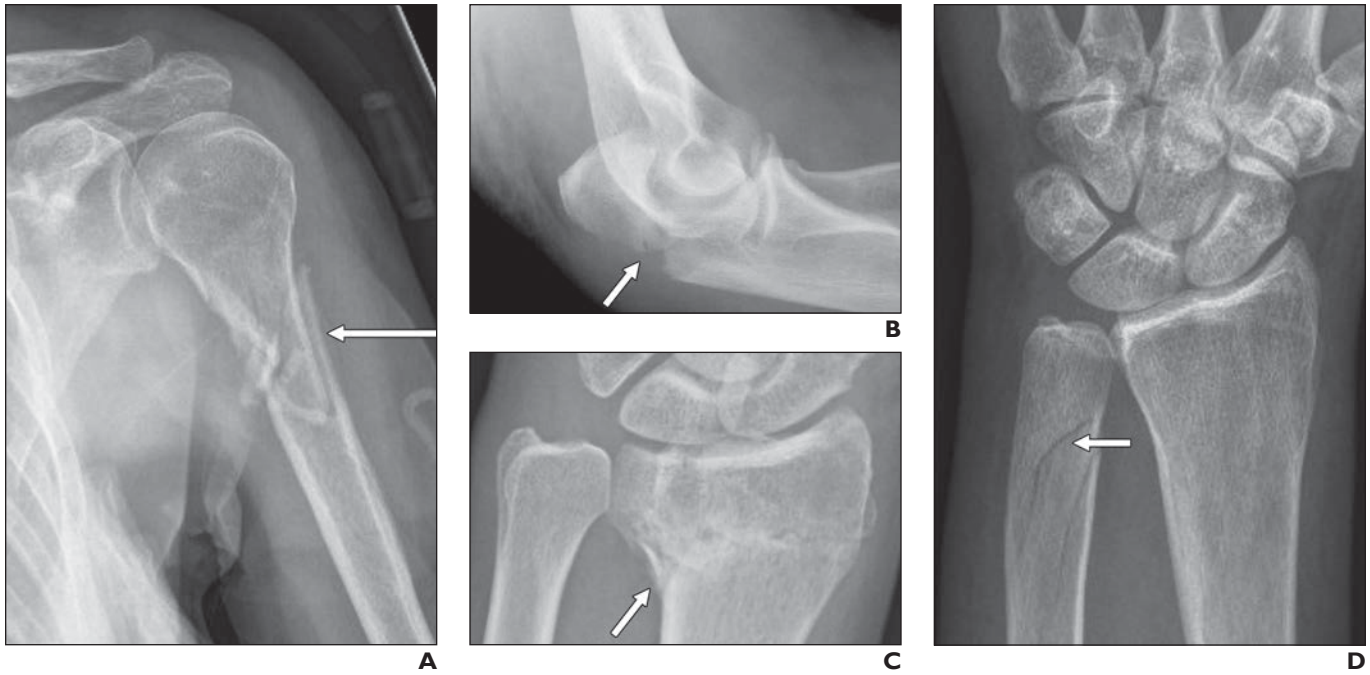


Fig. 5—Upper extremity fractures from intimate partner violence.
A, 58-year-old woman with left shoulder pain. Radiograph shows comminuted fracture (*arrow*) of proximal left humerus.
B, 53-year-old woman with reported history of fall. Radiograph shows distracted intraarticular olecranon fracture (*arrow*) with large joint effusion.
C, 44-year-old-woman with blunt trauma. Radiograph shows mildly displaced and impacted fracture (*arrow*) of distal radial metaphysis.
D, 59-year-old woman whose right forearm was pinned by partner. Radiograph shows minimally comminuted distal ulnar fracture (*arrow*) without marked displacement.

Downloaded from www.ajronline.org by 88.24.148.67 on 02/13/25 from IP address 88.24.148.67. Copyright ARRS. For personal use only; all rights reserved



Fig. 6—Lower extremity fractures from intimate partner violence.
A, 47-year-old woman with trauma and pain in right foot. Radiograph shows minimally displaced, mildly depressed, intraarticular fracture (*arrow*) of medial aspect of first proximal phalanx.
B, 33-year-old woman whose partner dropped weight onto her great toe. Radiograph shows minimally displaced tuft fracture (*arrow*) of distal right great toe with associated mild soft-tissue swelling.

native cause [21, 22]. One study of IPV-related maxillofacial injuries showed the most commonly fractured sites, in order of decreasing frequency, to be the nose, mandible, and orbit [26]. Yet, a study performed in India, where traffic accidents exceed assault as the most common trauma mechanism, showed that the most common fracture in women with maxillofacial fractures was mandibular fractures, followed by zygomaticomaxillary complex fractures [36]. These findings indicate differences in the predominant patterns of facial fracture patterns in IPV and accidental trauma. Therefore, in patients with nasal fracture but no mandibular or zygomatic injury after a traffic accident, IPV should be considered as an alternative cause.

Extremity injury patterns also vary between IPV and accidental trauma. For example, Khurana et al. [38] found that among upper extremity injuries, the finger was the most common fracture site in IPV (34.3%) and accidental striking (e.g., by a blunt object) (53.3%) but less commonly a result of accidental fall (10.1%). Therefore, a finger fracture in a patient presenting for accidental fall may require further investigation. Additionally, shoulder fractures occurred more commonly in IPV (9.2%) than in accidental falls (7.4%) or strikes (2.9%). Shoulder fractures may result from being shoved against a wall or to the floor or from receiving a direct blow. A shoulder fracture in a patient who reports being accidentally struck or falling should therefore warrant consideration of IPV as an alternative cause. Finally, nightstick fractures (fractures of the ulnar shaft) are classic defensive injuries and do not typically occur in falls on an outstretched hand [35]. The odds of a forearm fracture in IPV are 2.5 times those of such a fracture in accidental strikes. Thus, female patients with forearm fractures who report an accidental strike should be asked about IPV [38].

Fracture patterns often differ on the basis of the mechanism of injury. Displacement, dislocation, and comminution appear to be uncommon in IPV-related injuries, likely because of the lower energy of trauma in IPV than in accidental trauma, such as motor vehicle collisions (Fig. 8). In a study of patients with IPV-related injuries to the face, Gujrathi et al. [26] found that 94.5% of facial injuries exhibited minimal or no displacement and that 39.4% of injuries caused only soft-tissue swelling or hematoma without fracture. Figure 9 shows an example of a patient with right periorbital soft-tissue swelling without underlying fracture. In addition, among 62 patients with isolated ulnar fractures, 12 of whom had recently experienced IPV, 91.7% of IPV-related fractures, compared with 44.1% of non–IPV-related fractures, were nondisplaced [34]. Finally, in a study of IPV-related upper extremity fractures, only 17% were comminuted or displaced [34]; in that study, 92% of hand fractures were nondisplaced and noncomminuted.

Imaging Use Patterns as a Diagnostic Clue

Persons experiencing IPV undergo four times as much imaging as age- and sex-matched control individuals [15]. Therefore, a high frequency of imaging use may support suspicion of IPV. Conversely, this patient group is less likely to seek preventive care, including mammography, than are persons not experiencing IPV [18], which may lead to decreased utilization of breast imaging. IPV presentations also appear to have a temporal pattern. A retrospective review of assault-related injuries from 2005 to 2017, based on NEISS data, revealed that all assaults except for robberies had a peak incidence in midsummer. Most assaults occurred on weekends (late Saturday or early Sunday). However, IPV was most frequent on weekends in the spring and winter [39].

Intimate Partner Violence in Male Patients and Older Patients

Although most data about IPV focus on women in heterosexual relationships, IPV must also be considered in other patient groups [6]. Men are often considered to be the perpetrators of IPV, but IPV against men is profoundly underreported for a variety of reasons, including gender stereotypes, fear of ridicule, and potential adverse effects on child custody if the man is accused of being the primary aggressor [40]. Khurana et al. [41] using NEISS data found that among patients older than 60 years reporting experiences with IPV, men constituted 36%. Moreover, men and persons older than 60 years needed hospital admission after IPV more frequently than did other groups [41, 42]. In men, IPV more frequently results in lacerations, whereas in women, IPV more frequently results in contusions, abrasions, and internal head injuries [41, 42]. This difference reflects a higher frequency of cutting injuries in men during

Downloaded from www.ajronline.org by 88.24.148.67 on 02/13/25 from IP address 88.24.148.67. Copyright ARRS. For personal use only; all rights reserved

IPV [40]. It is critical for radiologists to recognize the prevalence of IPV among men, especially older men, given the increased reluctance of these patients to disclose their IPV status.

Reporting Difficulties

Even if correctly suspecting IPV-related injuries on the basis of imaging findings, the radiologist must decide whether to include this suspicion in the radiology report. The routine release of radiology reports through patient web portals is federally mandated in the United States [43]. However, the release of potentially damaging information without a safety plan is controversial [44]. Patients may have varying emotional reactions to particular results and could become less likely to seek future care. Inclusion of IPV suspicion in the report could lead to a loss of confidentiality in the event of a data breach [44]. In addition, access to the report by the violence-committing partner may worsen the situation or pose



Fig. 7—Finger injuries from intimate partner violence.
A, 43-year-old woman whose partner hit her left hand with chair. Radiograph shows displaced and angulated fracture (*arrow*) of distal fifth proximal phalanx.
B, 37-year-old man with crush injury to right thumb. Radiograph shows comminuted intraarticular fracture (*arrow*) of base of first metacarpal.
C, 21-year-old woman with trauma and pain in left hand. Radiograph shows nondisplaced, extraarticular, transverse fracture (*arrow*) of base of third proximal phalanx.
D, 31-year-old woman whose thumb was slammed between window and sill. Radiograph shows nondisplaced transverse, predominantly extraarticular fracture (*arrow*) of distal phalanx of thumb.
E, 25-year-old woman with reported fall striking her finger. Radiograph shows nondisplaced oblique fracture (*arrow*) of distal proximal phalanx of ring finger.

Downloaded from www.ajronline.org by 88.24.148.67 on 02/13/25 from IP address 88.24.148.67. Copyright ARRS. For personal use only; all rights reserved

Downloaded from www.ajronline.org by 88.24.148.67 on 02/13/25 from IP address 88.24.148.67. Copyright ARRS. For personal use only; all rights reserved



Fig. 8—Comparison of fractures from intimate partner violence and accidental causes.
A, 19-year-old woman who sustained right hand injury during altercation with partner. Radiograph shows transverse fracture (*arrow*) through midshaft of fifth metacarpal.
B, 32-year-old woman with injuries from motor vehicle collision. Radiograph shows comminuted fracture of distal humerus.

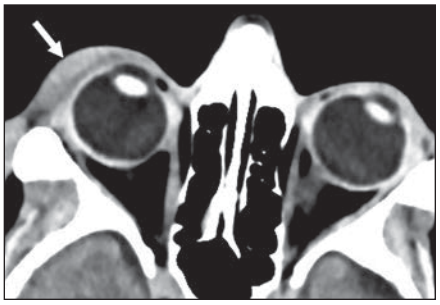


Fig. 9—57-year-old man who presented to emergency department with multiple bruises of head and face. Axial CT image of face shows right extraconal periorbital soft-tissue swelling (*arrow*) without underlying fracture.

an immediate threat to safety. For example, the aggressor could threaten further violence and confinement and seek to prevent the patient from seeking care [45]. Thus, IPV-related imaging findings must be communicated with care (Fig. 10). Approaches that lack documentation, such as telephone calls to other health care practitioners caring for the patient to clarify the clinical history and provide a context for image findings, may be considered. Inclusion of IPV suspicion in radiology reports is optimally performed in the context of a multidisciplinary institutional framework for IPV management that includes physicians across specialties, social workers, and established methods for providing patients with education, resources, support, and a safety plan.

Artificial Intelligence for Comprehensive Evaluation of Patients' Imaging Histories

Radiologic assessment of likelihood of IPV is best performed by considering all available current and prior imaging. Park et al. [46] found that through assessment of a patient's entire imaging history, radiologists were able to identify IPV earlier than when the patient self-reported IPV. Chen et al. [47] developed a predictive algorithm using machine learning and natural language processing to facilitate review of patients' entire history of radiology reports and identify patients in whom suspicion of IPV is warranted. This model predicted IPV a median of 3.08 years earlier than the patient's entry into a violence prevention program with specificity of 95%. Integrating this algorithm into the electronic medical record could aid implementation of clinical decision support tools for calculating IPV risk for all patients at the point of care. An automated alert based on the clinical decision support tool could be accompanied by an indication of the patient's specific risk factors for IPV, to guide health care practitioners when questioning patients about IPV [21].

Conclusion

IPV is a highly prevalent public health issue with multiple adverse health effects. Radiologists are well suited to assess a patient's likelihood of IPV. Recognition of common IPV injury mechanisms and resulting target and defensive injury patterns on imaging and understanding of differences in imaging utilization between patients experiencing and those not experiencing IPV will aid radiologists in accurate IPV diagnosis. Target injuries often involve the face and neck as a result of blunt trauma or strangulation; defensive injuries often involve the extremity. Awareness of differences in injury patterns resulting from IPV-related and accidental trauma can aid

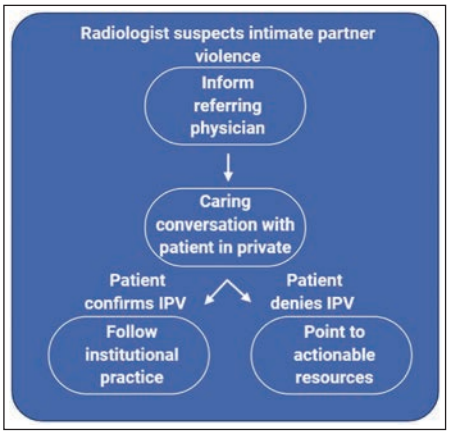


Fig. 10—Chart shows proposed procedure for radiologists to follow when suspecting intimate partner violence (IPV). (Reprinted by permission from Springer Nature Customer Service Centre GmbH: Springer Nature *European Radiology* 2021; 31:2126–2131, Addressing intimate partner violence during COVID-19 pandemic and beyond: how radiologists can make difference, Matoori S, Khurana B, Balcom MC, et al., 2020, www.springer.com/journal/330) [52])

radiologists in detecting a mismatch between the provided clinical history and the imaging findings to support suspicion of IPV. Radiologists should consider all available current and prior imaging in assessing the likelihood of IPV; this process may be aided by machine learning methods. Even if correctly suspecting IPV on the basis of imaging findings, radiologists face challenges in acting on that suspicion, including appropriately documenting the findings, without compromising the patient's confidentiality and safety. However, through a multidisciplinary approach with appropriate support mechanisms, radiologists may serve as effective frontline physicians for raising suspicion of IPV.

Provenance and review: Solicited; externally peer reviewed.

References

1. Miller E, McCaw B. Intimate partner violence. *N Engl J Med* 2019; 380:850–857
2. World Health Organization. *Violence against women prevalence estimates, 2018: global, regional and national prevalence estimates for intimate partner violence against women and global and regional prevalence estimates for non-partner sexual violence against women*. World Health Organization, 2021
3. Garcia-Moreno C, Jansen HA, Ellsberg M, Heise L, Watts CH; WHO Multi-country Study on Women's Health and Domestic Violence Against Women Study Team. Prevalence of intimate partner violence: findings from the WHO multi-country study on women's health and domestic violence. *Lancet* 2006; 368:1260–1269
4. Lutgendorf MA. Intimate partner violence and women's health. *Obstet Gynecol* 2019; 134:470–480
5. Smith SG, Chen J, Basile KC, et al. *The national intimate partner and sexual violence survey (NISVS): 2010–2012 state report*. National Center for Injury Prevention and Control, Centers for Disease Control and Prevention, 2017
6. Dicola D, Spaar E. Intimate partner violence. *Am Fam Physician* 2016; 94:646–651
7. Breiding MJ, Smith SG, Basile KC, Walters ML, Chen J, Merrick MT. Prevalence and characteristics of sexual violence, stalking, and intimate partner violence victimization: national intimate partner and sexual violence survey, United States, 2011. *MMWR Surveill Summ* 2014; 63:1–18
8. Wake AD, Kandula UR. The global prevalence and its associated factors toward domestic violence against women and children during COVID-19 pandemic: "the shadow pandemic"—a review of cross-sectional studies. *Womens Health (Lond)* 2022; 18:17455057221095536
9. Gosangi B, Park H, Thomas R, et al. Exacerbation of physical intimate partner violence during COVID-19 pandemic. *Radiology* 2021; 298:E38–E45
10. United Nations Office on Drugs and Crime. Global study on homicide: gender-related killing of women and girls. United Nations Office on Drugs and Crime, 2018
11. MacMillan HL, Wathen CN, Jamieson E, et al. Screening for intimate partner violence in health care settings: a randomized trial. *JAMA* 2009; 302:493–501
12. Brown JB, Lent B, Brett PJ, Sas G, Pederson LL. Development of the Woman Abuse Screening Tool for use in family practice. *Fam Med* 1996; 28:422–428
13. Overstreet NM, Quinn DM. The intimate partner violence stigmatization model and barriers to help-seeking. *Basic Appl Soc Psych* 2013; 35:109–122
14. Ahmad I, Ali PA, Rehman S, Talpur A, Dhingra K. Intimate partner violence screening in emergency department: a rapid review of the literature. *J Clin Nurs* 2017; 26:3271–3285
15. George E, Phillips CH, Shah N, et al. Radiologic findings in intimate partner violence. *Radiology* 2019; 291:62–69
16. Houry D, Feldhaus K, Peery B, et al. A positive domestic violence screen predicts future domestic violence. *J Interpers Violence* 2004; 19:955–966
17. Breiding MJ, Basile KC, Smith SG, Black MC, Mahendra R. Intimate partner violence surveillance: uniform definitions and recommended data elements—version 2.0. www.cdc.gov/violenceprevention/pdf/intimatepartnerviolence.pdf. 2015. Accessed Aug 5, 2022
18. Massetti GM, Townsend JS, Thomas CC, Basile KC, Richardson LC. Healthcare access and cancer screening among victims of intimate partner violence. *J Womens Health (Larchmt)* 2018; 27:607–614
19. Narayan AK, Lopez DB, Miles RC, et al. Implementation of an intimate partner violence screening assessment and referral system in an academic women's imaging department. *J Am Coll Radiol* 2019; 16(4 pt B):631–634
20. Brown JL. Responsibilities and risks when radiologists evaluate patients for child abuse. *AJR* 2013; 200:948–949
21. Khurana B, Seltzer SE, Kohane IS, Boland GW. Making the "invisible" visible: transforming the detection of intimate partner violence. *BMJ Qual Saf* 2020; 29:241–244
22. Alessandrino F, Keraliya A, Lebovic J, et al. Intimate partner violence: a primer for radiologists to make the "invisible" visible. *RadioGraphics* 2020; 40:2080–2097
23. Loder RT, Momper L. Demographics and fracture patterns of patients presenting to US emergency departments for intimate partner violence. *J Am Acad Orthop Surg Glob Res Rev* 2020; 4:e20.00009
24. Le BT, Dierks EJ, Ueeck BA, Homer LD, Potter BF. Maxillofacial injuries associated with domestic violence. *J Oral Maxillofac Surg* 2001; 59:1277–1283; discussion, 1283–1284
25. Sun EX, Goralnick E, Salim A, Khurana B. Imaging and non-imaging findings of intimate partner violence on the trauma service: a retrospective analysis of two level 1 trauma centers. *Acad Radiol* 2022 May 18 [published online]
26. Gujrathi R, Tang A, Thomas R, et al. Facial injury patterns in victims of intimate partner violence. *Emerg Radiol* 2022; 29:697–707
27. Daugherty JC, Verdejo-Román J, Pérez-García M, Hidalgo-Ruzzante N. Structural brain alterations in female survivors of intimate partner violence. *J Interpers Violence* 2022; 37:NP4684–NP4717
28. Valera EM, Cao A, Pasternak O, et al. White matter correlates of mild traumatic brain injuries in women subjected to intimate-partner violence: a preliminary study. *J Neurotrauma* 2019; 36:661–668
29. Malek AM, Higashida RT, Halbach VV, et al. Patient presentation, angiographic features, and treatment of strangulation-induced bilateral dissection of the cervical internal carotid artery: report of three cases. *J Neurosurg* 2000; 92:481–487
30. De Boos J. Tracheal perforation from non-fatal manual strangulation. *J Forensic Leg Med* 2019; 66:1–3
31. Funk M, Schuppel J. Strangulation injuries. *WMJ* 2003; 102:41–45
32. Gosangi B, Wong A, Gujrath R, et al. Imaging patterns of thoracic injuries in survivors of intimate partner violence (IPV). *Emerg Radiol* 2022 Nov 23 [published online]
33. Bhandari M, Dosanjh S, Tornetta P 3rd, Matthews D; Violence Against Women Health Research Collaborative. Musculoskeletal manifestations of physical abuse after intimate partner violence. *J Trauma* 2006; 61:1473–1479
34. Bhandari M, Dosanjh S, Tornetta P 3rd, Matthews D; Violence Against Women Health Research Collaborative. Musculoskeletal manifestations of physical abuse after intimate partner violence. *J Trauma* 2006; 61:1473–1479
35. Thomas R, Dyer GSM, Tornetta P III, et al. Upper extremity injuries in the victims of intimate partner violence. *Eur Radiol* 2021; 31:5713–5720
36. Khurana B, Sing D, Gujrathi R, et al. Recognizing isolated ulnar fractures as potential markers for intimate partner violence. *J Am Coll Radiol* 2021; 18:1108–1117
37. Matteoli M, Piacentino D, Kotzalidis GD, et al. The clinical and radiological examination of acute intimate partner violence injuries: a retrospective analysis of an Italian cohort of women. *Violence Vict* 2016; 31:85–102

Downloaded from www.ajronline.org by 88.24.148.67 on 02/13/25 from IP address 88.24.148.67. Copyright ARRS. For personal use only; all rights reserved

38. Ramisetty S, Gaddipati R, Vura N, Pokala S, Kapse S. Maxillofacial injuries in women: a retrospective study of 10 years. *J Maxillofac Oral Surg* 2017; 16:438–444
39. Khurana B, Raja A, Dyer GSM, et al. Upper extremity fractures due to intimate partner violence versus accidental causes. *Emerg Radiol* 2022; 29:89–97
40. Khurana B, Prakash J, Loder RT. Assault related injury visits in US emergency departments: an analysis by weekday, month and weekday-by-month. *Chronobiol Int* 2022; 39:1068–1077
41. Douglas EM, Hines DA. The helpseeking experiences of men who sustain intimate partner violence: an overlooked population and implications for practice. *J Fam Violence* 2011; 26:473–485
42. Khurana B, Hines DA, Johnson BA, Bates EA, Graham-Kevan N, Loder RT. Injury patterns and associated demographics of intimate partner violence in men presenting to U.S. emergency departments. *Aggress Behav* 2022; 48:298–308
43. Khurana B, Loder RT. Injury patterns and associated demographics of intimate partner violence in older adults presenting to U.S. emergency departments. *J Interpers Violence* 2022; 37:NP16107–NP16129
44. Lye CT, Forman HP, Daniel JG, Krumholz HM. The 21st Century Cures Act and electronic health records one year later: will patients see the benefits? *J Am Med Inform Assoc* 2018; 25:1218–1220
45. Holder J, Tocino I, Facchini D, et al. Current state of radiology report release in electronic patient portals. *Clin Imaging* 2021; 74:22–26
46. Vranda MN, Kumar CN, Muralidhar D, Janardhana N, Sivakumar PT. Barriers to disclosure of intimate partner violence among female patients availing services at tertiary care psychiatric hospitals: a qualitative study. *J Neurosci Rural Pract* 2018; 9:326–330
47. Park H, Gujrathi R, Gosangi B, et al. Longitudinal imaging history in early identification of intimate partner violence. *Eur Radiol* 2022; 32:2824–2836
48. Chen IY, Alsentzer E, Park H, et al. Intimate partner violence and injury prediction from radiology reports. *Pac Symp Biocomput* 2021; 26:55–66
49. Gosangi B, Lebovic J, Park H, et al. Imaging patterns of lower extremity injuries in victims of intimate partner violence (IPV). *Emerg Radiol* 2021; 28:751–759
50. Watane GV, Gosangi B, Thomas R, et al. Incidence and characteristics of spinal injuries in the victims of intimate partner violence (IPV). *Emerg Radiol* 2021; 28:283–289
51. Reis BY, Kohane IS, Mandl KD. Longitudinal histories as predictors of future diagnoses of domestic abuse: modelling study. *BMJ* 2009; 339:b3677
52. Matoori S, Khurana B, Balcom MC, et al. Addressing intimate partner violence during the COVID-19 pandemic and beyond: how radiologists can make a difference. *Eur Radiol* 2021; 31:2126–2131

Downloaded from www.ajronline.org by 88.24.148.67 on 02/13/25 from IP address 88.24.148.67. Copyright ARRS. For personal use only; all rights reserved