Scabies: A Review of Diagnosis and Management Based on Mite Biology

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Author Disclosure
At the time he wrote this article, Dr Levitt was the Vice-President of Taro Pharmaceuticals, USA, Inc, which manufactures a malathion product, and a stockholder. Dr Golant has no financial interests relevant to this article. The article does include discussion of unapproved therapeutic agents.

Objectives After completing this article, readers should be able to:

1. Understand the biology and life cycle of the mite Sarcoptes scabiei var hominis.
2. Know how to diagnose a scabies infestation.
3. Recognize the three basic clinical presentations of scabies: classic, crusted and nodular.
4. Understand how scabies is transmitted and the risk of infestation to contacts.
5. Know the principles of managing scabies, including pharmacologic treatment and the prevention of recurrence.

Introduction Scabies is a parasitosis caused by the mite Sarcoptes scabiei var hominis, with crusted scabies being more contagious than classic scabies because of a larger mite burden. Scabies is found primarily in poor and overcrowded conditions but can affect individuals of all ages and socioeconomic status without regard to level of hygiene. The predominant disease manifestations are mediated through inflammatory and hypersensitivity reactions to mites and mite products. (1) Hallmarks of infestation include intense itching, papular rash, and emotional disturbance from the concept of arthropod infestation. Complications of bacterial infection are a cause of significant morbidity in developed but especially in less developed countries. Effective scabies control requires treatment of affected patients, their close contacts, and environmental fomites. Control is difficult to achieve because of delayed or missed diagnosis, improper application of medication, inadequate treatment, or poor compliance. Treatment with most scabicidal medications calls for treating with an initial dose and re-treating 7 days later; however, the biological basis for when optimally to re-treat has never been documented.

Mite Biology and Life Cycle
The scabies mite is an obligate parasite that burrows in the epidermis of human skin, on average within 30 minutes after first contact. (2)(3)(4)(5) The adult mite burrows at 0.5 to 5.0 mm per day into the stratum corneum and deposits feces in its path; female mites also lay eggs. (6) Eggs hatch into larvae within 2 to 3 days, which then leave the burrow to mature on the skin surface. In 10 to 11 days, females mature into egg-laying adults. (7) The total life span of the adult female is approximately 5 weeks. Adult mites have eight legs, making them easily distinguishable from less mature larval forms, which have six legs. (3)(8) During maturation on the skin surface, larval mite forms are capable of burrowing into the patient’s epidermis or moving to a different host. Mites can crawl as fast as 2.5 cm per minute on warm skin. (8)

Scabies mites can survive off the human host and remain capable of infestation for an average of 24 to 36 hours at room conditions (21°C and 40%–80% relative humidity) and up to 19 days in a cool, humid environment. (2) A mite’s ability to infect a host decreases with increased time off of the host. (2) Adult mites use odor and thermotaxis to identify a new host. (9)

Diagnosis Accurate diagnosis of scabies infestation is an imperfect science. Given the extensive differential, correct clinical diagnosis rates among inexperienced clinicians is low. Furthermore, it

Abbreviations
BIT: burrow ink test
Ig: immunoglobulin
KOH: potassium hydroxide

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often is difficult to distinguish among active infestation, residual skin reaction, and reinfection. In practice, diagnosis often is made (or excluded) empirically from correlation of clinical symptoms with suggestive skin lesions or history of contact with a known scabies case; however, using such correlation will both overdiagnose and underdiagnose actual cases.

Scabies can be diagnosed by a variety of methods: potassium hydroxide (KOH) scraping of a burrow, dermoscopy, magnification of digital photography, skin biopsy, and clinical presentation, which typically includes itchy red papules and contacts with a similar rash. The gold standard involves direct visualization of the mite or its eggs. Direct visualization can be achieved by KOH preparation of a skin scraping taken from a burrow (Fig 1 A and B) or biopsy of a burrow demonstrating a mite (Fig 2). KOH testing provides excellent specificity (few false-positives) but low sensitivity (many false-negatives) because of the small number of parasites found in a typical host who has classic scabies. (1) Because scybala in isolation on a slide (Fig 3) can look like debris of nonscabies origin, the presence of scybala alone should not be considered diagnostic. Biopsy showing only perivascular inflammatory cell infiltrates with numerous eosinophils, edema, and epidermal spongiosis is merely suggestive and not definitive. (10) A recent article asserts that the visualization of only “pink pigtail” structures connected to the stratum

![Figure 1. KOH-prepared skin scrapings. A. Mite egg. B. Scraping taken from burrow demonstrating intact whole mite.](image1)

![Figure 2. Biopsy of crusted scabies. Note the large mite burden, perivascular inflammatory infiltrate, and epidermal spongiosis (hematoxylin-eosin stain; original magnification ×10).](image2)

![Figure 3. Scybala (fecal pellets) in isolation on a slide. Because of the resemblance to nonscabetic debris, microscopic visualization of scybala alone should not be considered diagnostic of scabies.](image3)
corneum (Fig 4), representing empty mite egg casings, suggests scabies. (11) Dermoscopy (12) and magnification of high-resolution digital photography (13) (Fig 5) are also good diagnostic methods, albeit less definitive than visualizing a mite on KOH preparation or biopsy. Dupuy et al (12) reported 91% sensitivity and 86% specificity for dermoscopy by experienced users, with slightly lower specificity for inexperienced users. Selecting an appropriate lesion for diagnostic testing is especially important because excoriated or inflamed lesions are less likely to harbor the mite or mite products. (14) Acral areas, such as the wrists and finger webs, are the best sites to sample; however, any skin that contains a red papule with central burrow should yield a mite.

Alternative methods of diagnosis include the burrow ink test (BIT), in which suspicious papules are marked with ink and then wiped off with an alcohol pad to remove the surface ink from the lesion. A positive BIT result (Fig 6) occurs when the ink tracks down the mite burrow, forming a characteristic dark, zigzagged line that is readily apparent to the naked eye. This test is useful if one does not have digital camera, microscope, dermatoscope, or skin biopsy capabilities. Epiluminescence microscopy (“jet-with-contrail” pattern) (15) and high-resolution videodermatoscopy are newer, noninvasive techniques that allow inspection of the skin in vivo from the surface to the superficial papillary dermis. (1) Studies of more advanced tests, such as polymerase chain reaction antigen detection, intradermal skin test, and enzyme-linked immunosorbent assay antibody detection are in progress. (1)

**Clinical Presentation**

Scabies has three basic clinical presentations: classic, crusted, and nodular. Classic scabies, the most common form, produces symptoms of severe pruritus (worse in the evening), fatigue, irritability, and, in some patients, fever from secondary impetigo or cellulitis. The parasite burden in classic
scabies usually is low, with an average of 10 to 12 mites during the first 3 months of infestation. (3)(16) The classic sign of scabies is the burrow (Fig 7), a serpigenous grey line in the skin formed by the digestive properties of secretions from the advancing mite. (4)(17) In classic scabies, skin lesions have a predilection for the interdigital web spaces of hands, flexor surfaces of wrists, extensor surfaces of elbows, periumbilical skin, axillae, genitalia, and the periareolar region in females (Fig 8 A–D). Contrary to popular belief, burrows may not be present in tropical climates, nor are they requisite in children. (2)(4)(8)(9) Although a single burrow is highly sensitive diagnostically, burrows often are obliterated by bathing, scratching, crust formation, or superinfection. (6) In the authors’ experience, a burrow is observed in most scabies cases diagnosed in nontropical climates. Hypersensitivity of both immediate and delayed types has been implicated in the development of lesions other than burrows. (18) Note, however, that the degree of rash does not correlate with the number of mites present.

Crusted scabies occurs in immunocompromised patients, such as those on long-term immunosuppressive therapy (ie, organ transplant recipients) or those with HIV or human T-lymphotropic virus type 1 infection. Other susceptible groups are mentally or physically handicapped patients, such as those who have paralyzed limbs, sensory neuropathy, or leprosy, because they may be unable to feel the itch or to scratch. (19) An older and now disfavored term for crusted scabies is “Norwegian scabies,” a reference to affected Norwegian patients with leprosy. (20) Progression from classic scabies is uncommon. (1) Crusted scabies is a psoriasiform dermatitis, frequently associated with hyperkeratotic skin crusts, peripheral cosinophilia, and high immunoglobulin (Ig) E and IgG levels. Crusted scabies can present in a generalized or focal manner, with manifestations limited to the scalp, face, nails, or soles. (1) Interestingly, about 50% of patients who develop crusted scabies report only mild pruritus or none at all. (21) Fissure development and secondary bacterial infections are common and are partially responsible for the high mortality associated with this form of the disease.

Although crusted scabies is caused by the same mite that causes classic scabies, the mite density in crusted scabies is much greater and can range from thousands to millions per patient, compared with the dozen or so mites typically found in classic scabies. (18) This difference accounts for crusted scabies being considerably more infectious than classic scabies. One study found that up to 4,700 mites per g of skin were counted in skin shed from hyperkeratotic patients, suggesting that crusted scabies predisposes contacts of the patient to infection through infested fomites in addition to direct contact. (22) Patients afflicted with crusted scabies also pose a treatment dilemma because eradicating the mite and egg burden from heavily crusted areas of the skin is difficult.

Nodular scabies is an uncommon variant (18) characterized by extremely pruritic reddish brown nodules up to 2 cm in size that typically are found on the genitalia, buttocks, groin, and axillae. Nodules are considered to be the result of hypersensitivity reactions to mite products because mites almost never are identified in these lesions. Nodular scabies can create a treatment dilemma because nodules can persist for weeks after treatment and may require corticosteroid injections. (21) Often, patients will demand repeat therapy with scabicides, and overly aggressive repeat therapy must be tempered with reassurance that the nodules eventually will resolve with appropriate anti-inflammatory therapy.

Transmission and Affected Contacts
It can take 4 to 6 weeks after initial mite exposure to develop signs or symptoms of scabies infestation. This delay in symptom development (“clinically latent period”) is responsible for undetected transmission and is thought to be due to delayed type IV hypersensitivity reaction against mites and mite products. (21) Evidence for this cell-mediated immune response has been confirmed by histologic examination of scabies lesions, which often show inflammatory cell infiltrates composed of eosinophils, lymphocytes, and histiocytes. (1) If patients are
reinfested, symptoms can reappear within days. Scabies also evokes a humoral immune response, demonstrated by high peripheral IgG and IgE levels and dermal IgE deposits found on biopsy of affected patients. (23)(24) The potential for diagnostic delay following initial infestation poses challenges for treating and eradicating scabies in both the source patient and any close contacts.

Scabies theoretically can be contracted by the transfer of eggs, larvae, or mature mites to the skin of the new host (25); however, mature mites are the most likely culprits. Early studies by Mellanby (3)(26) demonstrated that direct body contact was the predominant route for scabies transmission, and the number of scabies mites is directly proportional to risk of transmission. Mellanby found that of 300 volunteers who lay nude in warm beds recently vacated by scabetic hosts infected with <20 mites, 4 (1.3%) became infested. The number rose to 15% when hosts had >50 mites (3 of 20 volunteers became infested).

Scabies mites dislodged from an infested individual use odor and thermotaxis to identify a new host. (9) For these stimuli to be sufficient, individuals must be in close skin-to-skin contact, as occurs during sexual intercourse or when children sleep in the same bed. Bedding,
clothing, furniture, and other environmental sources can act as fomites, especially in crusted scabies, in which a high parasite load resides in shed scales. Transmission among family members is most common, supported by evidence from molecular studies that show the genotype of mites from household members is more homogeneous than the genotypes of mites from separate households within a community. (22)

Differential Diagnosis
Almost all pruritic dermatoses must be considered in the differential diagnosis (Table 1) because scabies can closely mimic a wide range of other skin conditions. The likelihood of a certain diagnosis varies according to the age of the patient and the setting. Various infections, arthropod assault, bullous dermatoses, and cutaneous lymphoproliferative disorders can all mimic scabies. Of note, scabies can present like bullous pemphigoid, having bullae associated with eosinophils and a positive direct immunofluorescence. (34)

Scabies in children often is missed until close contacts present with similar symptoms. Typical and atypical scabies skin lesions are found more often in areas of the body that are historically spared in adults, including the scalp, face, palms, soles, and intertriginous areas (Fig 8 A and B). (3)(9) In this population, scabies can be easily confused with atopic dermatitis or infantile acropustulosis, a condition characterized by transient episodes of acrally distributed pruritic vesicles and pustules. Indeed, a true infantile acropustulosis may follow treated scabies. Several case reports document misdiagnosis of scabies as Langerhans cell histiocytosis. (30)(31)(32)(33) Furthermore, especially in poor countries, children are more likely to present with scabies complicated by bacterial superinfection. (21)

The elderly are another challenging population with respect to the presentation of scabies. In this age group, cutaneous manifestations of classic scabies can be atypical, which may reflect an altered host immune response to the mite. Diagnostic delay in this population is common and of particular concern because itching is often dismissed as “senile pruritus” or anxiety. (18) In institutional settings, diagnostic delay allows for spread to others in the facility. The potential for misdiagnosis in pediatric or elderly patients can lead to inappropriate long-term application of potent topical corticosteroids, which predisposes these already vulnerable populations to more severe forms of the disease, including crusted scabies. Long-term corticosteroid use can also affect the presentation of routine scabies, with vesicles, pustules, and nodules predominating over classic skin lesions. (37)

Complications
Scabies-associated morbidity is frequently underestimated when considering the impact of the disease. In addition to the discomfort and loss of sleep caused by intense pruritus, patients can become secondarily infected from bacterial entry into excoriated skin. Bacterial transmission can also occur directly from the mite itself because Staphylococcus aureus and nephritogenic strains of group A Streptococcus have been isolated from mites and fecal pellets. (4) Scabies infection can lead to impetigo, furuncles, or cellulitis that can progress to acute poststreptococcal glomerulonephritis and rheumatic heart disease. (14) Such complications are of greatest concern in tropical regions and are seen less often in dry climates. (1)(4)(38) When bacterial superinfection is suspected, concomitant treatment with topical or systemic antibacterial agents should be started as soon as possible.

Other scabies complications include postscabies pruritus, a well-described pruritic condition that can last for days to weeks after the primary infestation and is thought to result from hypersensitivity to mites and mite products. (14) Practitioners should avoid confusing this complication with a treatment failure to avoid overprescribing scabicidal medication. Postscabies pruritus can be controlled with oral antihistamines or corticosteroids, and a trial of phototherapy may be warranted in resistant cases.


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<th>Impetigo</th>
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<td>Folliculitis/furunculosis</td>
<td>Allergic reaction/drug rash</td>
<td>Lymphomatoid papulosis</td>
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<td>Tinea corporis</td>
<td>Psoriasis</td>
<td>Dermatitis herpetiformis</td>
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<td>Syphilis</td>
<td>Eczema</td>
<td>Langerhans cell histiocytosis (especially in children)</td>
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<td>Insect bites (eg, bed bugs, fleas, chiggers)</td>
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<td>Animal scabies</td>
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Finally, the mere concept of insect infestation can cause serious psychological and emotional distress for some patients, including feelings of shame, guilt, and persistent delusions of parasitosis. (14) The best way to prevent these types of complications is to educate patients about the disease to alleviate fears and help improve compliance with treatment to ensure an expeditious cure.

**Principles of Treatment**

The choice of scabies treatment is based on effectiveness, potential toxicity, type of disease, and the patient’s age. In general, there is a lack of randomized controlled trials comparing the efficacy of topical scabies treatments; however, excellent clinical success rates with permethrin 5% cream, malathion 5% lotion, and oral ivermectin at 200 μg/kg make them all good treatment options. Generally recommended principles of treatment include treating the source patient concomitantly with any close contacts and sanitizing fomites and domicile.

When treating an individual, topical agents should be applied to the entire body surface with particular attention to the face (including eyelids), groin, back, under the nails, and in and behind the external ears. If hands are washed before the typically recommended 8-hour application time, the topical agent should be reapplied to the hands. Classic dogma, mainly originating from the package insert of topical scabicidal medications, does not provide explicit guidelines for treatment of the face or scalp. (39)(40) There is no physiologic basis for not treating these areas, and even cases of classic, noncrusted scabies in adults have been reported to affect the forehead. (41) That said, many cases of scabies are treated successfully without treating the scalp. In children, the elderly, and in tropical climates, the face and scalp should be treated routinely. (9)

The authors’ personal practice in New York involves empiric scalp treatment in a heavier infestation or if there is failure with initial therapy that did not include scalp treatment. Fingernails should be cut and subungal debris should be cleaned. Of course, if there is coexisting superinfection, topical or systemic antibiotics should be started as soon as possible and should be continued in conjunction with the scabies treatment. It is important to remember that pruritus can persist for up to 4 weeks after successful treatment as a result of hypersensitivity reactions and can be treated with antihistamines and anti-inflammatory agents, such as medium-potency topical corticosteroids.

In the case of crusted scabies, crusts can harbor thousands of mites. Keratolytics should be added to the treatment regimen until the hyperkeratosis has resolved. Typically, cases of crusted scabies require more cycles of re-treatment than classic scabies. Although judgments about therapy are dependent on clinical assessment of mite and scale burden, in our experience, three and rarely four rounds of topical or oral therapy are necessary to treat crusted scabies.

When treating fomites and the home environment, all clothing, bedding, and towels can be decontaminated by drying them at 60°C for 10 minutes; washing is not necessary. (8) Indeed, if a typical dryer cycle lasts 20 minutes, two loads of laundry can be treated with one dryer cycle (providing some monetary savings). Arlian et al (42) took dust samples from homes of scabetic hosts, 81% of whom had moderate to heavy infestation but no hyperkeratosis (scaling and/or crusting), and found that 44% of samples contained live mites. Live mites were recovered mostly from bedroom floors, couches, chairs, and mattresses. Vacuuming the floors of the bedroom and bathroom, as well as heavily used couches and chairs, is prudent in all cases and integral in cases of crusted scabies. Mites can survive off of the host for up to 19 days in cool, humid environments, but most die after 36 hours at room temperature. (2) Thus, the alternative is not to use contaminated fomites for a minimum of 2 days (or up to 3 weeks for those who wish to take every possible precaution). We feel 3 weeks is too extreme for classic scabies but might be appropriate for crusted scabies, for example, in the event of treatment failure.

**Clinical Contexts**

When devising a treatment plan for close contacts, one must take into account the context of the infestation—inpatient versus outpatient. For an individual case of classic scabies in the outpatient setting, treatment is targeted toward the source patient and any close contacts, whether or not contacts exhibit symptoms (in light of the clinically latent period that can last up to 6 weeks). Because the commonly used topical scabicides are essentially innocuous, it is not necessary to examine close contacts before prescribing topical therapy. We believe that it is more beneficial to ensure simultaneous treatment of contacts than to delay therapy for examination and counseling.

For an individual case of crusted scabies, the host patient should be treated with a regimen adequate to eradicate crusted scabies (ie, sufficient repeat cycles of therapy ensuring elimination of scale), and practitioners should use increased vigilance in warning any contacts about potential exposure owing to the increased infectivity of crusted scabies. Special attention should be paid to at-risk populations, including children, immunosuppressed patients, and the neurologically impaired. Of course, fomite
decontamination is of increased importance in crusted scabies.

When a patient with classic scabies is identified in an institutional setting, the affected patient must be put on contact isolation and all close contacts must be informed, educated about delayed onset of symptoms, and offered treatment. Close contacts may be defined as those who have extended, nongloved physical contact, including visitors, doctors, phlebotomy and radiology technicians, nurses, and other patients residing in the same room. When multiple cases are identified in one institution contemporaneously, there often is a source patient who has crusted scabies.

When a source patient with crusted scabies is identified in an institution, the previously mentioned precautions should be taken, in addition to informing and screening other staff, such as phlebotomists and nursing assistants, and patients on the same floor, even if there is no evidence of direct contact with the source patient. One should inform, screen, and empirically treat the laundry staff because of possible exposure to mites from shed skin during laundering of bedding and other fomite sources. More comprehensive fomite decontamination, including all chairs, curtains, furniture, and floors in patient rooms and waiting areas, is appropriate. For patients leaving the facility within 6 weeks after the outbreak, it may be easiest to treat empirically at discharge; otherwise, a note to the receiving facility should be provided.

For community outbreaks, the goal of treatment is to decrease the burden of disease dramatically rather than eliminate the outbreak altogether. This goal is accomplished through community education, treatment of all community inhabitants, decontamination of fomites, and monthly screening of patients and contacts. In small communities, particularly isolated island or rural populations, infestation rates of 33% have fallen to <1% by such methods in one study, and from 29% to <10% in another study after community-wide permethrin treatment. (43)(44) Reintroduction of scabies into treated communities will always be present, but with screening programs in place, epidemics can be avoided.

**Rational Recommendations for Treatment and Re-treatment**

Package inserts of topical scabicide medications advise treating patients with a single application, noting that one treatment typically is curative. (39)(40) Lindane prescribing information instructs to treat from the neck down because of safety considerations, (40) and permethrin prescribing information states that scalp treatment for adults is not necessary because infestation is uncommon in this population, but recommends re-treatment at day 14 if mites are again detected. (39)

To make a rational basis for therapy, akin to that done for head lice, (45) we need to know if a given therapy has ovicidal as well as scabicide activity. Because there is a lack of information on this point, we must assume the worst case scenario: that therapies are not ovicidal. We must also understand the scabies life cycle, which has been elegantly elucidated by Arlian et al. (42) As stated earlier, an egg hatches after a maximum of 3 days and takes a minimum of 8 days to mature to an egg-laying adult. Treatment at day 0 would kill all the mites. Hatchlings from eggs laid just before therapy would become infectious on day 3. Thus, re-treating at day 3 or 4 (allowing for outlier late hatchlings) appears a more rational approach. In this case, hatchlings, as well as any adult survivors from the initial therapy, are exposed to therapy.

Although controlled clinical studies in monitored settings may yield high cure rates, in practice, treatment failures from a single application are common. For this reason, we recommend empiric re-treatment at day 4 for confirmed cases. Naturally, if one assumes that a drug is both scabicide and ovicidal, a high success rate should be achieved with one application. Provided all contacts were treated in the 4-day window, there does not seem to be a benefit in waiting beyond 4 days to re-treat the infected patient, for the following reasons: (1) contacts are not often treated exactly at the same time; (2) fomites are not decontaminated consistently; and (3) a single application is not always effective (owing to application error or poor compliance). A delay in re-treatment allows time for establishment of greater disease burden and greater potential for spread to others if there is any failure of the first treatment.

Although we posit that re-treatment on day 4 will lead to better clinical outcomes, these recommendations are not substantiated by clinical data and thus need to be validated through randomized controlled clinical trials with each agent.

**Pharmacotherapy of Scabies**

**Permethrin**

Permethrin 5% cream is accepted as the current gold standard for scabies treatment because of an efficacy of ~90% in most studies from the past two decades (4)(43)(44)(46)(47)(48)(49)(50)(51)(52)(53)(54)(55) and an excellent safety profile. Permethrin is labeled for application to the entire body for 8 to 12 hours, usually right before bedtime. According to a 2007 Cochrane review, permethrin is the most effective topical scabicide, significantly more efficacious than crotamiton and lindane.
In addition to its superior efficacy, permethrin also has an excellent safety profile. Compared with lindane, permethrin is less toxic, has lower percutaneous absorption, and produces lower blood and brain concentrations when applied topically. Permethrin is indicated and is safe for use in newborns, young children, and pregnant (category B) and lactating women. (14) Although there are reports of confirmed in vivo resistance to permethrin in scabies mites, in vitro resistance of scabies mites to permethrin has been well demonstrated, (5)(57)(58) and concerns about in vivo mite resistance have recently been described in a number of Aboriginal communities in northern Australia. (5)(57)(58)(59)(60)

Malathion
Malathion 0.5% lotion is approved for the treatment of head lice in the United States but is not currently indicated for the treatment of scabies. In the United Kingdom, malathion is approved for scabies and is available over the counter. Malathion requires two applications 7 days apart. (61) A few small studies have demonstrated malathion’s efficacy in scabies, with cure rates ranging from 83% to 100%. (62)(63)(64)(65) The safety profile of malathion, which is excellent, is reviewed by Idriss and Levitt. (41)

Because malathion is available as a runny lotion, it may be more appropriate than scabicide creams for treatment of hairy areas of the body, such as the scalp. (41) Adverse effects of malathion include occasional skin irritation and conjunctivitis with eye contact.

Ivermectin
Ivermectin is used off label as an oral medication for scabies, alone or in combination with a topical agent. Most large studies to date have shown that one or two doses of ivermectin (200 µg/kg, 3–9 days apart) produced cure rates equivalent to treatment with conventional topical medications (benzyl benzoate, lindane, permethrin) for classic scabies. (21) Efficacy rates from several open-label studies of ivermectin (one to two doses) for the treatment of classic scabies since 1996 have ranged from 76% to 100%. (66)(67)(68)(69)(70)

A single dose of ivermectin yielded a 70% cure rate, which increased to 95% with a second dose at 2 weeks. (55) The temporal and additive nature of this clinical response suggests that ivermectin may lack ovicidal properties and thus may not be effective during all stages of the mite life cycle. (21) Based on our knowledge of the scabies mite life cycle and ivermectin’s short half-life (18 hours), treating patients with two doses of ivermectin 4 days apart seems to be a more rational regimen. (71)

Based on its route of administration, ivermectin holds the greatest potential for treating scabies in the context of epidemic or endemic outbreaks. Topical scabicides have the potential to be applied inappropriately and are generally poorly tolerated by bedridden patients because they can be challenging for staff to apply. (14) Therapy with a tablet is relatively quick and efficient and virtually guarantees whole-body exposure. For that reason, ivermectin has also been efficacious for the treatment of severe crusted scabies in adults and older children, usually when given in multiple doses and in combination with topical permethrin. (21)

Potential adverse effects of ivermectin include hepatotoxicity, tachycardia, and hypotension. (71) Owing to limited safety data and a less developed blood-brain barrier, ivermectin is not recommended for use in children younger than 5 years of age or in pregnant or lactating women. (72) Of note, ivermectin is a P-glycoprotein inhibitor, which can lead to serious toxicity if used in conjunction with other P-glycoprotein substrates, such as methotrexate, cyclosporin, digoxin, and some anticancer treatments. (73)(74)

These treatments comprise most of scabies therapy in the United States and are those that the authors feel are most effective. The following medications can also be used.

Crotamiton
Crotamiton 10% cream is labeled for topical application from the chin down, with repeat application suggested at 24 hours. Although crotamiton is labeled for application over 1 to 2 days, daily application for 5 days has produced better cure rates. (4)(9)(50)(58) Safety for the use of crotamiton in newborns and infants has not been well established. Results from a double-blind randomized study proved that crotamiton cream is significantly less efficacious than permethrin. (50) Potential adverse effects from crotamiton cream include erythema and conjunctivitis. In addition, high resistance rates have been reported after a single application of 8 to 12 hours. (50)(75)

Lindane
Cure rates from four early studies ranged from 49% to 96% when measured at 4 weeks after a single topical application of lindane. (76) Treatment failures are attributed largely to resistance. Lindane’s use is greatly limited by safety concerns regarding its potential neurotoxicity. The spectrum of serious neurologic adverse effects includes irritability, vertigo, seizures, vomiting, diarrhea, and syncope. (21) Lindane currently carries a black box warning in the United States because of reported deaths from its use, and the drug is banned in ~50 countries, mainly
because of its persistence in the environment. One bottle of lindane contaminates 6 million gallons of water, costing $4000 of wastewater clean-up per treatment. (77)

Benzyl Benzoate

Benzyl benzoate is a scabicide used alone or in combination with topical sulfafluram. It is labeled for use in adults and in diluted form for children, infants, and breastfeeding mothers. (21) Different treatment regimens have been proposed (including single versus multiple applications), but no comparative data are available. Benzyl benzoate is not approved for use in the United States. Although cure rates in one study were lower for benzyl benzoate when compared with oral ivermectin, (78) in vitro testing has shown benzyl benzoate kills scabies mites more rapidly than permethrin and may be a useful alternative to permethrin in severe crusted scabies. (24) (57) Benzyl benzoate should be washed off within 24 hours after application because it is a known irritant that can cause contact dermatitis. (18) Analgesics and antihistamines can be used as pretreatment to diminish the application discomfort, if necessary. If ingested, benzyl benzoate can cause difficulty urinating, jerking movements, and loss of consciousness. (4) (58) (78) (80) When used in combination with sulfafluram, treatment with benzyl benzoate can mimic the effect of disulfiram; thus, it is advised to avoid alcohol ingestion for at least 48 hours after treatment. (18)

Summary

• Scabies is a contagious parasitic dermatitis that is a significant cause of morbidity, especially outside of the United States. Scabies is diagnosed most often by correlating clinical suspicion with the identification of a burrow.
• Although scabies should be on the differential for any patient who presents with a pruritic dermatosis, clinicians must consider a wide range of diagnostic possibilities. This approach will help make scabies simultaneously less over- and underdiagnosed by clinicians in the community.
• Atypical or otherwise complex presentations may necessitate the use of more definitive diagnostic modalities, such as microscopic examination of KOH-prepared skin scrapings, high-resolution digital photography, dermoscopy, or biopsy.
• Scabies therapy involves making the correct diagnosis, recognizing the correct clinical context to guide treatment of contacts and fomites, choosing the most effective medication, understanding how to use the agent properly, and following a rational basis for when to use and reuse that agent.

• Although the development of new therapeutic agents is always welcome, tried and true treatments are still effective today. Permethrin is the gold standard therapy, with malathion being an excellent topical alternative. Ivermectin is an effective oral alternative that is especially useful in crusted scabies, patients who are bedridden, and in institutional outbreaks.
• Despite the availability of effective therapeutics, treatment failures still occur, mostly secondary to application error (ie, failure to treat the face and scalp or close contacts, failure to reapply medication) or failure to decontaminate fomites.
• Because increasing resistance to scabies treatments may be on the horizon, we propose that standard of care for scabies treatment should involve routine treatment of the scalp and face and re-treating patients at day 4 on the basis of the scabies life cycle to ensure more efficient mite eradication.
• Practitioners should attempt to treat all close contacts simultaneously with the source patient.
• To eradicate mites, all fomites should be placed in a dryer for 10 minutes on a high setting, furniture and carpets vacuumed, and nonlaunderables isolated for a minimum of 2 days, or, for those who wish to be rigorous, 3 weeks.

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Care of the Well Newborn

Johanna B. Warren, MD,*
Carrie A. Phillipi, MD, PhD, FAAP†

Objective After completing this article, readers should be able to:

1. Understand the unique features of the physiology of the newborn and how care of the infant addresses these elements.
2. Know the physical and behavioral characteristics of full-term and post-term infants.
3. Understand the elements involved in feeding the neonate, as well as ways breastfeeding can be encouraged.
4. Be aware of optimal hospital policies in caring for newborns, including the concept of family-centered care.
5. Understand the management of common problems encountered in care of the newborn, such as jaundice, passage of meconium before birth, and respiratory distress.

Introduction

The birth of an infant is a time of great joy but also a time of significant change for families. Typically, a large amount of historical information is collected, new data are integrated, and synthesized knowledge is taught to parents during a brief hospitalization surrounding an infant’s birth. Family routines are in flux and complex physiologic changes are occurring in both the mother and infant. In the midst of this time of great transition, clinicians should remember that care of the family should be accessible, continuous, comprehensive, family-centered, coordinated, compassionate, and culturally effective. The concept of a medical home starts for the child at the prenatal visit and extends through the birth and beyond, when a clinician and family begin a relationship to promote healthy growth and development. The principles of the medical home are described in Fig 1. (1)

Antenatal Care

Stated simply, the goals of antenatal care are to prevent maternal and neonatal complications associated with pregnancy and childbirth. This care should be cost-effective and evidence-based. Care should focus on maternal risk factor identification and reduction, as well as patient education. Finally, antenatal care should be available to all women, regardless of their socioeconomic or insurance status.

Ideally, antenatal care starts before conception, with healthy lifestyle choices and guidance from primary care clinicians regarding the importance of folic acid supplementation; smoking cessation; attention to and treatment of mental health disorders; and importance of exercise, diet, and ideal body weight. Once pregnant, women seek care from a variety of maternity care providers: nurse midwives, family physicians, obstetricians, and maternal-fetal medicine specialists. Regardless of discipline, a chosen maternity care provider then meets a woman and her partner/family, establishes a relationship, and sets expectations for the pregnancy and birth.

Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>GBS</td>
<td>group B streptococcal</td>
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<tr>
<td>LGA</td>
<td>large for gestational age</td>
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<tr>
<td>SGA</td>
<td>small for gestational age</td>
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<tr>
<td>TdaP</td>
<td>tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis, adsorbed</td>
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<tr>
<td>TTN</td>
<td>transient tachypnea of the newborn</td>
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<tr>
<td>USPSTF</td>
<td>US Preventive Services Task Force</td>
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The first few visits in early pregnancy should focus on establishing early pregnancy dating (via last menstrual period or early ultrasound) as well as risk factor identification. Comprehensive review and documentation of the maternal medical history (including medication and supplement use), obstetric and gynecologic history, family history, genetic history, and social/occupational history are critical to providing comprehensive care. Screening for substance abuse, mental health disorders, and domestic violence are just as important in the care of the maternal/fetal dyad as routine prenatal laboratory analysis.

Many women (now regardless of age) opt for early genetic screening in the first trimester of pregnancy with blood testing (maternal serum pregnancy-associated plasma protein A and β-human chorionic gonadotropin) coupled with ultrasound to measure the nuchal translucency of the fetus. In the second trimester, a maternal blood test for alpha fetoprotein is added, and the results are integrated from both tests, giving pregnant women a numerical risk of carrying a fetus with aneuploidy or open spina bifida. In addition, nearly all women are offered a detailed anatomy screening ultrasound in their second trimester of pregnancy.

Given the explosion of use and the increasing sensitivity of these technologies, antenatal visits may be used to discuss and plan for necessary follow-up of suspicious prenatal ultrasound findings, such as prenatal hydronephrosis, single umbilical arteries, or other abnormalities. In these and more complicated situations, it may be necessary for the maternity care and pediatric provider to communicate and coordinate a variety of specialists before birth and develop a neonatal care plan both for the birth and immediately thereafter.

Integration of the Electronic Health Record

The infant’s primary care provider after hospital discharge will not always care for the neonate during the birth hospitalization. Increasingly, hospital-based clinicians care for newborns during this period, then transition care to outpatient pediatric care providers.

Given the myriad disciplines that provide antenatal outpatient maternity care, as well as the variety and scope of intrapartum care clinicians, obtaining an accurate and comprehensive maternal and family history to guide neonatal care can be an incredible challenge. Electronic health records afford the opportunity to link maternal and infant records and integrate medical care. Currently, these electronic health record systems are largely still a work in progress at many institutions and linking office-based systems with hospital-based systems still may pose challenges.

Robust maternal risk factor identification and documentation, laboratory and imaging data during pregnancy, and comprehensive documentation of labor course and delivery in a linked electronic medical record provides the essential information needed for neonatal clinicians to determine the infant’s appropriate medical care after birth.

Early Postpartum Period Transitioning

Labor and delivery is a physiologically stressful environment for both the mother and neonate. Maternity care providers commonly use electronic fetal monitoring as a tool when evaluating fetal well being during the labor process; however, there is little evidence that continuous electronic fetal monitoring in low-risk pregnancies improves outcomes. Uterine contractions decrease blood flow to the fetus. A healthy fetal-placental unit will allow

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**Figure 1. Principles of the patient-centered medical home.** Issued jointly by the American Academy of Family Physicians, the AAP, the American College of Physicians, and the American Osteopathic Association, 2007. Adapted from Kellerman R, Kirk L. Principles of the patient-centered medical home. *Am Fam Physician.* 2007;76:774–775.
the fetus to maintain a normal heart rate though this uterine contraction. If there is uteroplacental insufficiency, however, the fetal heart rate often shows characteristic changes (e.g., late decelerations) that may prompt an expedited vaginal delivery or cesarean delivery.

Both the timing and mode of deliveries are changing. In 1996, the cesarean birth rate in the United States was 20.7%; in 2006, this rate was 31.1%. Much of this increase reflects a decrease in the rate of attempted vaginal birth after cesarean delivery, with an increase in either primary elective or scheduled repeat cesarean deliveries. Infants born before 39 weeks of gestation in general are at risk for adverse outcomes, particularly transient tachypnea of the newborn (TTN).

Tita et al (2) showed elective cesarean deliveries before 39 weeks’ gestation (but >37 weeks’ gestation) were associated with increased rates of adverse respiratory outcomes, mechanical ventilation, newborn sepsis, hypoglycemia, NICU admissions, and hospitalizations at birth for more than 5 days. Tutu et al (3) confirmed the strong association between TTN and elective cesarean delivery and further demonstrated elective cesarean delivery at term gestation (>37 weeks) in the absence of fetal exposure to labor contractions is associated with an increased risk of and more severe course of TTN. In this same group, infants born vaginally or via cesarean after a labor course showed no increased risk for TTN. For these reasons, and for infant neurodevelopment, the March of Dimes Healthy Babies are Worth the WaitTM (http://marchofdimes.com/pregnancy/getready_atleast39weeks.html) campaign encourages waiting until at least 39 0/7 weeks’ gestation for elective labor induction or cesarean.

Obstetric analgesia and anesthesia are other important considerations for the neonatal care clinician. Options for pain control during labor and delivery include local anesthesia, parenteral analgesia (usually in the form of fentanyl, morphine, or nalbuphine), inhaled anesthetics (nitrous oxide), regional analgesia/anesthesia (epidural, spinal, combined spinal/epidural), and general anesthesia. Each has its own risks and benefits. Labor epidurals have become more common, and trials randomizing women to epidural analgesia or parenteral medications have shown an increased rate of maternal fever in the epidural groups (relative risk 4.0–4.6). (4) The mechanism currently is not known, and although there has been no demonstrated increased risk of neonatal sepsis, there has been an increase in neonatal sepsis evaluations.

### Early Assessments

In the immediate postpartum period, the newborn care team (usually a nurse and birth attendant) is responsible for attending to any needs for neonatal resuscitation. Approximately 10% of all neonates require some form of resuscitation. Standard Neonatal Resuscitation Program guidelines are comprehensive and evidence-based standards, which direct any necessary resuscitation. (5) All birth attendants should be familiar with neonatal resuscitation algorithms, equipment, and resources available in their practice settings. Team simulation-based trainings and certifications are becoming increasingly common and help maintain infrequently used skills.

Management of neonates at birth when meconium is present has changed in the past few years. If an infant is born vigorous, no suction or further exploration of the oropharynx or trachea is indicated. In the presence of meconium and a nonvigorous neonate, an attempt at visualization of the vocal cords with suction should be performed, but should not significantly delay any further resuscitative needs (such as positive pressure ventilation).

Apgar score assignment is a standardized way to communicate the clinical status of a newborn infant. The score traditionally is assigned at 1 and 5 minutes of life, but may be continued every 5 minutes as dictated by the clinical context. The score has five components: heart rate, respiratory effort, muscle tone, reflex irritability, and color. Each component is given a score of 0, 1, or 2 (see Table 1). A 5-minute Apgar score of 7 to 10 is considered normal. Apgar scores can be helpful in assessing an infant’s transition from intrauterine to extrauterine life and may reflect neonatal resuscitation efforts, but should not guide these efforts. Likewise, Apgar scores should not be used to predict neurologic outcomes or development of infants. Common

### Table 1. The Apgar Score

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<th>0</th>
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<tr>
<td>Heart rate</td>
<td>Absent</td>
<td>&lt;100 beats per min</td>
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<tr>
<td>Respiratory effort</td>
<td>Absent</td>
<td>Weak cry; hyperventilation</td>
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<td>Flaccid</td>
<td>Some flexion</td>
<td>Active motion/Well flexed</td>
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<td>Reflex irritability</td>
<td>No response</td>
<td>Grime</td>
<td>Cry/Cough/Sneeze</td>
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<td>Color</td>
<td>Blue/Pale</td>
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limitations to Apgar scoring include prematurity, congenital anomalies, exposure to drugs, and hypovolemia. (6)

Cord blood gas assessments provide more physiologic information on the neonate than Apgar scores. The most objective assessment of intrapartum hypoxia-ischemia is the presence of metabolic acidosis in umbilical arterial blood at the time of birth. (7) During normal labor, umbilical arterial pH drops and base deficit rises. Healthy term infants have an umbilical arterial pH of 7.27 ± 0.07 and base deficit of −2.7 ± 2.8 mM. A pure respiratory acidosis can be corrected rapidly by the neonate or by administering positive pressure ventilation at an appropriate rate. Neonates are unable to correct a metabolic acidosis quickly, however; thus, an umbilical arterial pH of <7.0 or base deficit >12 mM suggests increased risk (but not certainty) of neonatal neurologic morbidity.

Every effort should be made to promote skin-to-skin contact with the mother directly after birth for the stable infant. Newborns have a high surface area-to-body ratio, and thus are prone to heat loss. Infants who are cold become stressed and rapidly deplete their stores of fat and glycogen. The infant should be encouraged to breastfeed as soon as possible and within the first hour of birth. If skin-to-skin contact is not sufficient for a newborn to maintain his or her temperature, swaddling and the use of a radiant warmer in the delivery room are additional resources. The administration of standard newborn medications, such as erythromycin eye ointment and vitamin K, is another priority in the first hours of life.

Vitamin K is an important clotting factor synthesized by intestinal bacteria. All neonates are born with low levels of vitamin K because of the absence of gut flora but also because of low levels of transplacental passage and the inability of the fetal liver to store vitamin K. Vitamin K-deficient bleeding (formerly known as hemorrhagic disease of the newborn) can occur directly after birth or many weeks later, presenting as skin bruising, mucosal bleeding, bleeding at the umbilicus and circumcision site, or even fatal intracranial hemorrhage. Large hematomas at injection sites or on the head after delivery also may be presenting signs.

Maternal risk factors for the infant’s development of vitamin K-deficient bleeding include antiepileptic, antituberculin, and vitamin K antagonist medications. Human milk is a poor source of vitamin K, and infants with late hemorrhagic disease of the newborn often are those who are breastfed and did not receive vitamin K at birth. Vitamin K given to all babies after delivery in an intramuscular injection has been shown to prevent both early and late forms of bleeding. There is not enough information about the efficacy of oral vitamin K to recommend its routine use, although it is certainly better to use oral vitamin K than none at all when parents refuse the intramuscular formulation. There is no proven relationship between vitamin K administration and childhood cancer.

Erythromycin is the most commonly used medication to prevent ophthalmia neonatorum from Neisseria gonorrhoeae and Chlamydia trachomatis and is applied to the infant’s conjunctival sacs immediately after birth. Silver nitrate can be used but is less effective against Chlamydia and frequently causes a chemical conjunctivitis. Many developing countries use povodone iodine. A recent national shortage of erythromycin in the United States highlighted the need to identify an effective, inexpensive alternative to erythromycin, establish stores, or enhance production capability of erythromycin.

The initial newborn assessment, including a thorough examination of the infant for any anomalies and identification of infant and maternal risk factors necessitating further evaluation, typically is performed by a labor and delivery nurse or the birth attendant for low-risk deliveries. For higher-risk deliveries, a specialized neonatal resuscitation team may be present at the delivery and perform this assessment.

Assessing Growth and Gestational Age
At birth and as a child grows and develops, one of the most important things pediatric clinicians do is measure, record, and assess growth. This process starts at birth with basic measurements, including weight, head circumference, and length. The infant’s measurements are plotted on a growth curve according to gestational age. Infants who fall outside the normal weight range qualify as small for gestational age (SGA) or large for gestational age (LGA). SGA and LGA sometimes are defined as <10th percentile and >90th percentile, respectively, for gestational age, but also may be described as less than or greater than two SDs around the mean. Intrauterine growth restriction describes an infant whose growth is limited compared with his or her potential because of environmental, genetic, or other factors. All of these characterizations are important because they identify at-risk newborns.

The measurements for head circumference also require careful attention to detail and can indicate micro- or macrocephaly. The infant who is small but has preserved head size (asymmetric growth restriction) frequently has poor growth because of nutritional factors (placental insufficiency), whereas genetic conditions, environmental factors such as toxins, and congenital infections should be considered when the infant is symmetrically small with
microcephaly. These birth parameters are important to communicate to the follow-up care provider for future comparisons. There is some evidence that the current growth curves commonly used in newborn care require updating with our contemporary and genetically diverse population.

When the gestational age or due dates are uncertain, a gestational age assessment is completed using the Dubowitz/Ballard examination. (8)(9) Using such a tool, the clinician assesses the infant’s neuromuscular and physical maturity using a standardized examination. Neuromuscular maturity is based on the infant’s neuromuscular tone and reflexes; physical maturity assessments include the anterior-posterior progression of plantar creases and progression from transparency to cracking, the presence or absence and amount of lanugo, the extent of development of breast tissue, eye and ear development, and maturation of the genitalia. Scores are assigned for neuromuscular and physical characteristics. These scores are then combined to arrive at a maturity rating score approximating the newborn’s gestational age in weeks. This method of estimating gestational age is especially important for premature infants; however, each clinician should formally or informally assess each individual infant and determine whether the stated gestational age is supported by the physical examination.

The definition of the term infant is an infant born between 37 0/7 weeks’ and 42 0/7 weeks’ gestation. Every week of maturation is important, however, and many infants who qualify as “term” by gestational duration will encounter problems uncharacteristic of newborns delivered at 40 weeks’ gestation. Fetal development during gestation is a continuum just as it is after birth. In particular, the vulnerability of the late preterm infant (34 0/7 to 36 6/7 weeks’ gestation) is being recognized increasingly and pediatric clinicians should take special care with this population of newborns. (10)

Care Pathways

Newborn care in hospitals often is standardized to support those infants at risk for common yet specific conditions such as hypoglycemia, group B streptococcal (GBS) exposure, hepatitis B/HIV exposure, and maternal illicit substance exposure. Infants born to mothers with diabetes mellitus or those who are SGA, preterm, or LGA, as well as infants with birth asphyxia, are at risk for hypoglycemia. High-quality evidence to support the specifics of protocols for hypoglycemia screening is lacking but is presented here in generalized fashion. These infants should be observed closely for changes in level of consciousness (irritability, lethargy), apnea spells, poor feeding, hypothermia, hypotonia, tremors, or seizures. Symptomatic infants should have a blood glucose level drawn immediately and should have feeding or other intervention as appropriate for their condition. Asymptomatic infants at risk for hypoglycemia should have a blood glucose level drawn in the first 30 minutes of life and begin frequent feeding (ideally at breast) during the first 2 hours of life, with at least one additional blood glucose evaluation during this time period.

The Centers for Disease Control and Prevention updated their recommendations for the prevention of perinatal GBS disease in November 2010. (11) In short, asymptomatic infants born to mothers who do not receive adequate prophylaxis for GBS should at a minimum have careful clinical observation with consideration of a limited screen (complete blood count with differential, blood culture) in some circumstances and 48 hours of observation. If adequate maternal intrapartum antibiotic prophylaxis (≥4 hours) has been administered, observation of the newborn in a medical setting may be as short as 24 hours. Symptomatic infants should have a full evaluation completed to rule out sepsis, including at minimum a complete blood count with differential, blood culture, and initiation of intravenous antibiotics. This algorithm is depicted in Fig 2.

Infants born to HIV- or hepatitis B–positive mothers should be bathed at birth (before any injections). The infant born to an HIV-positive mother should be formula-fed only, and zidovudine should be initiated by 12 hours of life. Consultation with a pediatric infectious disease specialist (either by phone or in person) is encouraged. Finally, infants born with maternal substance exposure, such as opiates, are at risk for neonatal abstinence syndrome (withdrawal). (12) An abstinence scoring system (Finnegan is one example) should be initiated with vital signs recorded at least every 4 hours, as well as the use of soothing techniques and frequent feeding (breastfeeding is ideal). High abstinence scores or abnormal vital signs should trigger transfer from a normal newborn nursery to a higher level of care with consideration for initiation of opiate therapy (eg, morphine). Social work and lactation consultations can be useful. In these and other instances, care pathways allow for immediate identification and implementation of standardized monitoring and intervention.

Family–Centered and Team–Based Care

The advantages of rooming-in to promote breastfeeding and family-centered rounds, allowing maximal time for the newborn to bond with his or her new family, are increasingly recognized in family-centered care. Pediatric clinicians should understand the importance of the team in caring for the child, acknowledging the important role
various providers play during the birth hospitalization. Nurses, hearing screen specialists, phlebotomists, lactation consultants, obstetric providers, pediatric clinicians, doulas, case managers, social workers, and unit clerks all contribute to the care of an individual child. The hospital stay often is standardized for healthy newborns but can require a large amount of care coordination for those newborns with special medical or social needs. Family-centered care plans should promote the well being of the family with streamlined, team-based care, minimizing interruptions and promoting parent-infant bonding.

If for any reason an infant must be separated from his or her parents for medical reasons, every effort should be made to maintain parent-infant bonding and promote breastfeeding. Mothers who are unable to breastfeed their infants should have access to high-quality breast pumps and providers skilled in lactation.

Normal Development in the First Days of Life

The Newborn Examination

Ideally, a pediatric clinician’s examination is completed in the first 24 hours after birth. Nursing colleagues often have assessed the infant fully before this examination, and their evaluations should be viewed as complementary. The initial examination serves the purpose of identifying anomalies, as well as reassuring parents about the health of their new infant. Education, sometimes termed “discharge teaching,” should be regarded as a continuum, ideally initiated long before birth and continuing after birth with the first examination. Education may be reinforced best within the context of the examination itself, as the clinician identifies and discusses common findings, such as safe sleep positioning, skin and cord care, jaundice, and the voiding patterns common to the newborn.

The newborn’s appearance often can raise questions from a new family who might find their infant does not appear as typically portrayed in the media. Skin findings such as acrocyanosis (a localized blue-purple discoloration of the hands and feet caused by sluggish peripheral circulation) and vernix (a white covering that protected the infant in utero), as well as vascular birthmarks, often are present. The head often is molded through the delivery process, and the face and eyelids can appear puffy or bruised. Milia (white keratin inclusions), sebaceous gland hyperplasia, slate grey patches on the back and buttocks, and newborn rashes such as erythema toxicum are other common findings.

The post-dates infant (>42 weeks) is often LGA but has a unique appearance. The skin can be markedly cracked, in particular at the wrists and ankles. If placental insufficiency is present, the subcutaneous tissues may appear wasted. LGA infants may have difficulty progressing through the birth canal and should be assessed for trauma with evaluation of the Moro reflex and grasp symmetry, as well as special attention to identify clavicular fractures.
The birth hospitalization provides an important time for education regarding normal infant behaviors and development. Parents should be reassured about the normal loss of weight that occurs in the first days and educated about the evolution and recognition of jaundice. In addition, the early newborn period is one of great physiologic transition for the infant. Care in subsequent examinations should be taken to examine the infant systematically for signs of ductal-dependent cardiac lesions, respiratory difficulties, feeding problems, and jaundice. Neurodevelopmental milestones, such as the newborn’s ability to visually fixate, lift his or her head up when prone, and demonstrate reflexes such as the Moro or startle reflex and grasp and rooting reflexes, can be reviewed and demonstrated.

Breastfeeding

The benefits of breastfeeding cannot be overstated. A recent report concluded if 90% of families in the United States could comply with medical recommendations to breastfeed exclusively for 6 months, the United States would save billions of dollars per year and prevent an excess of 900 deaths, nearly all of which would be in infants. (13) This analysis did not include maternal benefits. Clear and unbiased information should be given to the family regarding the benefits of breastfeeding for both mother and infant. Individuals skilled in education and the assessment and management of breastfeeding problems should be readily available in the hospital and after discharge.

Many hospitals have established themselves as “Baby Friendly” according to the initiative by the World Health Organization (WHO) and United Nations Children’s Fund, launched in 1991 to promote maternity centers as centers of breastfeeding support. The Baby Friendly designation requires a process involving application and institution of 10 specific steps, as seen in Fig 3. (14) (For a discussion of the views of the American Academy of Pediatrics [AAP] on the 10 steps to successful breastfeeding, refer to Lawrence RM, Lawrence RA. Breastfeeding: more than just good nutrition. Pediatr Rev. 2011;32:267–280.)

Every facility providing maternity services and care for newborn infants should:

- Have a written breastfeeding policy that is routinely communicated to all health care staff.
- Train all health care staff in skills necessary to implement this policy.
- Inform all pregnant women about the benefits and management of breastfeeding.
- Help mothers initiate breastfeeding within one half-hour of birth.
- Show mothers how to breastfeed and maintain lactation, even if they should be separated from their infants.
- Give newborn infants no food or drink other than breast milk, unless medically indicated.
- Practice rooming in, that is, allow mothers and infants to remain together 24 hours a day.
- Encourage breastfeeding on demand.
- Give no artificial teats or pacifiers (also called dummies or soothers) to breastfeeding infants.
- Foster the establishment of breastfeeding support groups and refer mothers to them on discharge from the hospital or clinic.


Increasingly, care delivery involves partners such as certified lactation consultants, midwives, and others skilled in the evaluation and management of common breastfeeding challenges and problems. The AAP has designed a curriculum for resident education in breastfeeding. (15) Training programs for pediatric, family medicine, and obstetrics and gynecology residents are increasingly incorporating breastfeeding medicine into standard resident curricula. At many institutions, pediatric and obstetric providers are experts in breastfeeding medicine.

Although exclusive breastfeeding provides optimal nutrition for the vast majority of infants, supplemental nutrition occasionally is medically indicated. In addition, some families will choose to feed their infants formula; this informed choice should be respected. There are times when, even with ample resources and desire, breastfeeding is unsuccessful. Maternal milk banks are being instituted increasingly for the benefit of all newborns, including premature infants, and may eventually provide an alternate and superior source of nutrition for those mother-infant dyads in whom breastfeeding is not an option but the
families would prefer not to use formula. Dextrose water and sterile water are to be avoided because their use may result in hyponatremia and other electrolyte disturbances. Ankyloglossia should be detected as part of the standard newborn evaluation, and any infant with breastfeeding difficulty should be reassessed for the possibility of this condition. Frenotomy is an option for those infants who have ankyloglossia and are experiencing breastfeeding difficulty.

The WHO recommends that children breastfeed for at least 2 years. The AAP and American Academy of Family Physicians recommend that infants be exclusively breastfed for 6 months and continue breastfeeding with appropriate complementary foods for at least 1 year. The US Public Health Service’s “Healthy People 2020” set national goals of ~80% of infants breastfeeding at birth, ~60% at 6 months, and ~35% through 6 months to 1 year. (16) The United States fell short of the “Healthy People 2010” goals, let alone the “Healthy People 2020” and WHO recommendations. Recent national attention to breastfeeding through the Surgeon General’s Call to Action to Support Breastfeeding (17) may bolster our progress on this front.

A 2007 systematic review of the effects of breastfeeding on maternal and infant health found for both mothers and infants in developed countries, many health benefits and effects of breastfeeding persist beyond the period of breastfeeding. (18) It has been established that breastfeeding mothers lose more weight in the immediate postpartum period and breastfed infants are thought to have lower risks of common conditions, such as acute otitis media, gastroenteritis, and atopic dermatitis. Children who were not breastfed may be at increased risk for obesity, asthma, diabetes, and childhood leukemia. Similarly, for mothers, not breastfeeding is associated with increased risk of postpartum depression, type 2 diabetes, and development of breast and ovarian cancers.

A 2010 publication further investigated mothers 45 to 58 years old who were free of clinical cardiovascular disease. (19) Each woman underwent an assessment of markers for subclinical cardiovascular disease. Compared with mothers who had breastfed children for at least 3 months, mothers who had not breastfed were more likely to have increased risk of vascular changes associated with future cardiovascular disease.

One of the most significant barriers to duration of breastfeeding in developed countries is early return to the workforce postpartum. Employers should provide a dedicated clean space for women to nurse or express milk, flexibility in work schedule, accommodations to store pumped milk, and a supportive environment to achieve these goals. Many state and local governments have created legislation to support lactating women.

Jaundice

The development of jaundice or hyperbilirubinemia is a common phenomenon in newborn medicine. Most healthy newborns will have some degree of visible jaundice in the first week of life, but it is important to identify the rare infant who will go on to develop severe hyperbilirubinemia with its potential for bilirubin encephalopathy. Icterus progresses cephalocaudally, then to the extremities, typically peaking at 3 to 4 days. Visible jaundice in the first 24 hours always warrants investigation. Several factors contribute to cause hyperbilirubinemia. At birth, newborns have a robust hemoglobin level (14.0–22.5 g/dL) and increased red blood cell destruction.

Erythrocyte turnover results in the production of indirect bilirubin, which is conjugated in the liver by uridine diphosphate glucuronyltransferase. This enzyme is relatively immature in the healthy newborn, resulting in an indirect or unconjugated hyperbilirubinemia. Because it takes some time for breastfeeding to be established, the bilirubin that is conjugated can become unconjugated in the gut and re-presented by the process of enterohepatic circulation, contributing to indirect hyperbilirubinemia. Uridine diphosphate glucuronyltransferase enzymatic activity is deficient or reduced in some conditions (Crigler-Najjar syndrome, Gilbert syndrome) and polymorphisms have been identified in those of East Asian descent. This enzyme also is less functional in the presence of glucose-6-phosphate dehydrogenase deficiency in people of East Asian, Greek, and African descent.

The prevention of severe hyperbilirubinemia has been the subject of a great deal of attention and controversy. The Joint Commission has identified severe hyperbilirubinemia (defined as a bilirubin >30 mg/dL) as a reviewable sentinel event. (20) A sentinel event is any unexpected occurrence involving death or serious physical or psychological injury, or the risk thereof. In 2004, the AAP published a practice guideline for management of hyperbilirubinemia. (21) In this policy statement, the authors recommended screening by a universal test measuring bilirubin or screening based on clinical risk factors.

Since this time, the prevention of bilirubin encephalopathy by universal screening has received an “I” rating by the US Preventive Services Task Force (USPSTF) (the evidence is insufficient to recommend for or against routinely providing the service). (22) Recently, however, the implementation of universal bilirubin screening was demonstrated to reduce the incidence of severe hyperbilirubinemia, a surrogate for bilirubin encephalopathy, in
a large cohort. (23) Phototherapy usage increased with institution of universal screening. Universal bilirubin screening with serum or transcutaneous bilirubin measurements now is commonplace before hospital discharge. Still, the evaluation and management of hyperbilirubinemia requires a high degree of clinical acumen, careful attention to detail, and a team-based approach to evaluation (Table 2). Clinical estimation of jaundice alone without history and risk stratification is prone to error.

Weight Loss
Weight loss in newborns is observed frequently, but normative data are not well characterized in the literature. In general, weight loss of >10% to 12% in the first postnatal week is a cause for concern and necessitates a thorough evaluation. Families should be reassured about this progression and can become preoccupied with a normal process because this is a value commonly measured, reported, and compared in the course of routine newborn care. Numerical weight loss of concern in the presence of a progressively improving feeding relationship should not drive supplementation. It is typically taught that newborns should regain their birth weight by 2 weeks after the birth, although many newborns reach this value much sooner if feeding is well established. Emphasis should return to the feeding relationship between mother and infant and the promotion of breastfeeding. A great deal of normative data collection and evidence-based research has yet to be completed in newborn care. Numerical weight loss of concern in the presence of a progressively improving feeding relationship should not drive supplementation. It is typically taught that newborns should regain their birth weight by 2 weeks after the birth, although many newborns reach this value much sooner if feeding is well established. Emphasis should return to the feeding relationship between mother and infant and the promotion of breastfeeding. A great deal of normative data collection and evidence-based research has yet to be completed in newborn care. A research collaborative regarding newborn care (Better Outcomes through Research for Newborns) is being developed in affiliation with the Academic Pediatric Association (http://www.ambpeds.org/) and promises to provide normative newborn data.

### Table 2. Key Elements for Reducing Severe Hyperbilirubinemia

- Promote and support successful breastfeeding.
- Establish nursery protocols for the identification and evaluation of hyperbilirubinemia.
- Measure the total serum bilirubin or transcutaneous bilirubin level of infants jaundiced in the first 24 hours.
- Recognize that visual estimation of the degree of jaundice can lead to errors, particularly in darkly pigmented infants.
- Interpret all bilirubin levels according to the infant’s age in hours.
- Recognize that infants <38 wk’s gestation, particularly those who are breastfed, are at higher risk of developing hyperbilirubinemia and require closer surveillance and monitoring.
- Perform a systematic assessment for the risk of severe hyperbilirubinemia on all infants before discharge.
- Provide parents with written and oral information about newborn jaundice.
- Provide appropriate follow-up based on the time of discharge and the risk assessment.
- Treat newborns, when indicated, with phototherapy or exchange transfusion.


**Voiding and Stooling Patterns**

The infant typically passes a first meconium stool shortly after birth, often within the first hours and typically before 24 to 48 hours. These black, tarry, and sticky stools transition as the mother’s human milk production increases. This transition typically occurs in a pattern, often from green/brown to a seedy, loose, mustard yellow appearance. It is not rare for an infant to pass stool with nearly every breastfeeding when the mother’s milk is in because of the gastrocolic reflex signaling the colon to empty. When the passage of meconium stool is delayed, the provider can carefully recheck the infant’s anus for the normal characteristic stellate pattern and continue to observe if the infant is feeding well without abdominal concerns. Delayed passage of stool beyond 48 hours can indicate serious problems, such as colonic obstruction from imperforate anus with or without fistula, meconium plug syndrome, or Hirschsprung disease. Imaging, including barium enema, and rectal suction biopsy as the diagnostic gold standard for Hirschsprung should be considered.

The infant’s first urination nearly always occurs in the first 24 hours. Urine can be difficult to detect in the presence of frequent meconium stool, and the truly anuric infant is extremely uncommon. The evaluation of the anuric infant should include a reassessment of the pregnancy history, with special attention to decreased amniotic fluid (oligohydramnios) and anomalies of the urinary system on prenatal ultrasound that might indicate urinary obstruction. Feeding adequacy should be assessed and the notes reviewed to determine if the infant voided at delivery or elsewhere and the voiding was not recorded. One can then repeat the physical examination, paying particular attention to the genitalia and abdomen. If these
findings are all normal, the infant can continue to be observed. A cotton ball placed between the labia or a bag may be applied to collect urine if there is concern that the urine was simply not observed. If there are continued concerns for anuria, catheterization, bladder and renal ultrasound with urologic consultation, and evaluation of renal function can be considered. Commercially available diapers now commonly have a stripe that changes color in the presence of urine, which helps identify small amounts of urine.

Parents often have questions about the appearance of newborn urine, which can initially be scant and darkly colored. This inquiry provides a good opportunity to discuss urate crystals (often termed “brick dust”) and vaginal discharge. Urate crystals look different from blood in the newborn’s diaper but can be confused. They tend to sit on the surface of the diaper and are iridescent and completely benign. Vaginal discharge can be clear, yellow, or white, and even blood tinged as the female infant “withdraws” from maternal hormones.

A newborn should not be discharged until the passage of stool and urine can be documented.

Anticipatory Guidance, Screening Tests, and Routine Health Maintenance and Promotion

Anticipatory Guidance

The pediatric clinician’s goal should be to perform a complete assessment of the newborn while providing anticipatory guidance to the family. A sometimes overwhelming amount of information is given to a family during this brief hospitalization. Every effort to individulize, personalize, and teach in the context of the examination should be encouraged. Preventive health care and screening for both infant and mother are important components.

Anticipatory guidance always should include safe sleep positioning in which the infant is always placed on his or her back on a firm surface free of quilts, sleep positioners, or other soft objects, such as stuffed animals. During the hospitalization, safe sleep positioning should be modeled and promoted. The Back to Sleep campaign has resulted in a reduction in sudden infant death syndrome. (24)(25)

Breastfeeding and lack of exposure to tobacco are important, modifiable behaviors shown to reduce the risk of sudden infant death syndrome. Room but not bed sharing also is encouraged, and a pacifier can be offered once breastfeeding is established.

Parents often have questions about skin and cord care. The newborn infant does not require frequent bathing. Cleansers should be mild and the child should have sponge baths until the umbilical cord detaches. In the past, antibiotic ointments, dyes, and alcohol have all been applied to the umbilical cord, but this practice is unnecessary. Parents should keep the umbilical stump dry and allow it to fall off naturally, generally in 10 to 14 days. Long, flexible but sharp fingernails often are a source of concern for the new family. With good lighting and when the child is quiet, the nails can be clipped, cut, filed, or torn.

Care of the uncircumcised penis requires little effort. It can be cleansed externally when regular bathing is established. Retracting the foreskin of an infant is discouraged because it will likely cause pain, bleeding, and even adhesions. Over time, the natural separation of the foreskin from the glans will occur. After puberty, boys can learn to retract and cleanse under the foreskin in the shower as a part of their daily hygiene. If circumcised, the penis should be kept clean and simple petroleum ointment applied to keep the newly exposed glans from adhering to adjacent skin or diaper.

Pediatric clinicians have an opportunity during the course of newborn care to educate families about the dangers of abusive head trauma and to normalize infant crying. Hospital-based interventions, such as the Period of Purple Crying, from which families receive information on newborn crying and abusive head trauma have proven effective in educating families (http://www.purplecrying.info/). Techniques to soothe the infant should be taught, but parents should be given realistic information about behavioral expectations.

Fever, hypothermia, poor feeding, lethargy, and tachypnea are nonspecific signs and symptoms but they can indicate serious bacterial infection during infancy. Knowing whom to call and when and where to seek care in the first months of life is an important part of anticipatory guidance provided in the hospital.

Necessary travel from the hospital to home affords the opportunity to provide car seat safety information to families, which can seem confusing and even overwhelming. Recent studies support recommendations to remain rear-facing for longer periods of time. (26) The AAP recommends that all infants should ride rear-facing, starting with their first ride home from the hospital. All infants and toddlers should ride in a rear-facing car safety seat until they are 2 years of age or until they reach the highest weight or height allowed by their car safety seat’s manufacturer. Certified car seat safety inspectors at the hospital or in the community provide adjunctive support.

Screening Tests

State-mandated screening tests typically include newborn metabolic screening and hearing screening, the specific
components of which may differ from state to state. Supportive statements have been issued by the Agency for Health Care Research and Quality for screening for congenital hypothyroidism, phenylketonuria, and hearing loss. The USPSTF gives an A recommendation (high certainty the net benefit is substantial) for screening for congenital hypothyroidism and phenylketonuria in all newborn infants. (27) The USPSTF gives a B recommendation (high certainty the net benefit is moderate or there is moderate certainty the net benefit is moderate to substantial) for screening for hearing loss in all newborn infants, citing good-quality evidence that early detection improves language outcomes. (28)

In addition to these tests, in 2009, the AAP concluded universal pulse oximetry screening at >24 hours incurs very low cost and risk of harm at those birthing sites that have on-site pediatric cardiovascular services. (29) Since then, screening for critical congenital heart disease (CCHD) was recommended by the US Health and Human Services Secretary’s Advisory Committee on Heritable Disorders in Newborns and Children, but concerns regarding implementation prevented full support by the Secretary of Health and Human Services. More recently, an AAP work group found sufficient evidence supporting universal pulse oximetry screening to detect CCHD in well-infant and intermediate care nurseries. (30) To maximize positive predictive value, the screen should be accomplished at >24 hours, with screening values <96%, on the foot or >3% difference between the right hand and foot indicating the need for further evaluation. Oximetry should be considered an essential tool in the evaluation of any infant with a heart murmur, cyanosis, tachypnea, or signs of illness or poor feeding, as these could be presenting signs of undiagnosed congenital heart disease.

Some standard screening tests and other procedures are painful for the neonate. Pharmacologic and nonpharmacologic methods to relieve pain, as well as standardized assessments to assess pain, should be implemented. Breastfeeding and kangaroo care/skin-to-skin contact, as well as glucose/sucrose solutions, are options for reducing pain associated with routine minor procedures.

**Vaccination**

All newborns should receive vaccination at birth for hepatitis B. This vaccine is extremely effective in preventing hepatitis transmission. If the mother is hepatitis B surface antigen-positive, the infant should receive hepatitis B vaccine and hepatitis B immune globulin, administered in separate thighs, at birth. When the mother’s hepatitis serology results are unknown, the infant should receive the vaccine as soon as possible and within 12 hours of birth. The mother’s serology results should be sought and the clinician has 7 days to administer hepatitis B immune globulin if serology results are positive for hepatitis B surface antigen. It is recommended that discharge be deferred until the serology results have been determined. Some institutions give the hepatitis B vaccine at the time of vitamin K administration, immediately after delivery.

Efforts should be made to provide influenza and tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis, adsorbed (TdaP) vaccination to postpartum mothers and to recommend or provide opportunities for other caregivers to receive these vaccinations. Vaccination of caregivers for influenza and pertussis effectively cocoon the vulnerable infant until he or she can be fully vaccinated. Families are often unaware of these risks and are accepting of adult vaccinations even when they have concerns about childhood vaccination.

**Vitamin D**

The AAP updated its vitamin D recommendations in 2008, increasing the minimum daily intake of vitamin D to 400 IU per day, beginning soon after birth. (31) This advice replaces a prior recommendation of 200 IU per day of vitamin D. In practice, all infants, whether formula fed or breastfed, are unlikely to be able to achieve the recommended intake through feeding and require supplementation. Children should continue to receive 400 IU per day of vitamin D through adolescence.

**Discharge Readiness**

Discharge readiness includes the completion of all newborn care tasks and parental education, a well-established feeding plan, and follow-up, in particular for the evaluation of jaundice and breastfeeding problems. The AAP defines all discharges before 48 hours as early discharge and recommends follow-up for these infants within 1 to 2 days, and in 72 hours when an earlier visit is not possible. (32) Access to care is still a problem and home-based care frequently is unavailable in our current health care delivery system. Discharge readiness checklists have been developed by the AAP and Bright Futures. (33)

In situations in which the newborn is at high risk for development of severe hyperbilirubinemia, feeding problems, or problems related to prematurity, or when a safe plan for discharge cannot be formulated, the infant should not be discharged until proper arrangements are made. Often there will be pressures related to length-of-stay parameters that have not been formulated with the at-risk infant in mind, but by third party payers. Perinatal
social workers and case managers may be instrumental in facilitating necessary steps for an unanticipated extended neonatal hospitalization. Pediatric clinicians must continue to advocate for newborns individually and collectively so they receive the care they require and deserve.

Quality Indicators in Newborn Care
National quality indicators for newborn care are being developed. As we move toward the measurement and reporting of quality care, residents who often are on the front lines in academic medical centers are becoming involved increasingly in the design and implementation of systems and processes to deliver quality care. Neonatal mortality, percentage of term infants with Apgar scores <7 or umbilical arterial pH <7.2, and NICU admission, as well as serious bacterial infections commonly are reported and tracked. Exclusive breastfeeding at discharge, hepatitis B immunization, and hepatitis B immune globulin (when indicated) are some obstetric and neonatal measures proposed by the National Quality Forum and others. Many hospitals and care systems are measuring and reporting newborn hearing screening referral rates, maternal TdAP administration rates, bilirubin measurements, and phototherapy usage.

The Medical Home Revisited
Communication with outpatient care providers regarding the events and results of the birth hospitalization and information gathered on the pregnancy and family history during the newborn’s stay is the newborn care team’s responsibility. Inpatient maternal and newborn care providers should see themselves as an extension of the medical home. Follow-up needs should be communicated electronically (ideally via an integrated electronic health record), and in some cases by direct telephone communication. Families also should receive information about the events of the hospitalization at the time of discharge in a format and language they understand. Information and documents to be relayed to the primary care provider should be identified clearly.

Postpartum depression affects up to 15% of all mothers and is likely underrecognized and undertreated. Similar to depression in pregnancy, the negative short- and long-term effects on child development are well established. Both the maternity care provider and the pediatric provider (if not the same clinician) have roles in screening for and treating postpartum depression. Communication between the two is essential. Treatment options include medications and psychotherapy. Barriers to successful treatment include access to mental health care and mental health care professionals, concerns of breastfeeding mothers about exposure of the infant to antidepressant medication, knowledge and comfort of primary care providers in prescribing and monitoring medications, and financial and transportation barriers to care.

Special Circumstances
The Late Preterm Infant
Late preterm infants (typically defined as 34 0/7 to 36 6/7 weeks) deserve special consideration for their vulnerability. When thinking about these infants, it may be best when considering the gestational age to round it down to the last completed week rather than round it up (eg, a 36 5/7 week infant is described as a “36 weeker,” emphasizing their immaturity). Late preterm infants are at high risk for respiratory distress, temperature instability, hypoglycemia, jaundice, feeding problems, and readmission after discharge. (10) Transportation of the low birth weight (<2500 g) and preterm infant deserves special consideration, and car seat testing for these infants has been proposed. Some institutions have personnel who have been certified in the evaluation of car seat installment available to the newborn nursery.

The preterm infant has higher fluid and caloric requirements and often has feeding difficulty. Insensible losses are increased with exposure to radiant warmers, during phototherapy, and because of the preterm infant’s relative increase in body surface area. Mothers should begin pumping immediately after birth and lactation consultants are integral to the late preterm infant’s care. Supplemental feeding frequently is necessary. Jaundice can present later, and late preterm infants cannot safely tolerate the same levels of bilirubin as a term infant. Careful attention to the feeding patterns and risk factors for jaundice are crucial to prevent pathologic hyperbilirubinemia.

Integrated Care and Nontraditional Births
Some infants are born at home or in out-of-hospital birth centers. Most of these births are term gestations in low-risk pregnancies. When evaluating infants born out-of-hospital for the first time, it is especially important to review which standard screening tests or medications (newborn metabolic screen, vitamin K, erythromycin, hearing screening) have been offered and completed, and coordinate care for those still needed. The first newborn outpatient visit often can be arranged to meet the needs of the mother and infant with coordination of care among obstetric, pediatric, and lactation providers. Home visits provide an excellent opportunity to provide this care in a family-centered fashion.
Summary

• The birth of an infant is one of the most memorable experiences a family shares. Pediatric health care professionals are privileged to participate in this experience and recognize it as a time to promote the health of the newborn and family.
• Ideally, a well-designed care system would be replete with comprehensive supports during the prenatal period, birth, and transition to home.
• Opportunities exist to improve the care we deliver with universal screening of all pregnant women; coordinated assessments of family health, including mental health; and access to coordinated supports and services for mother and infant.

• If 90% of US families could comply with medical recommendations to breastfeed exclusively for 6 months, it is estimated that the United States would save billions of dollars per year and prevent more than 900 deaths, nearly all of which would be in infants.
• All infants, whether breastfed or formula fed, should receive 400 IU supplemental vitamin D.
• Influenza and Tdap vaccination of postpartum mothers and other caregivers helps cocoon the vulnerable infant from influenza and pertussis until he or she can be fully vaccinated.
• When children reach the highest weight or length allowed by the manufacturer of their infant-only seat, they should continue to ride rear-facing in a convertible seat. It is best for children to ride rear-facing as long as possible to the highest weight and height allowed by the manufacturer of their convertible seat.

Parent Resources From the AAP at HealthyChildren.org

The reader is likely to find material to share with parents that is relevant to this article by visiting this link: http://www.healthychildren.org/English/ages-stages/baby/pages/default.aspx.

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**PIR Quiz**

Quiz also available online at http://www.pedsinreview.aappublications.org. NOTE: Beginning with this issue, learners can take Pediatrics in Review quizzes and claim credit online only. No paper answer form will be printed in the journal.

**New minimum performance level requirements**

Per the 2010 revision of the American Medical Association (AMA) Physician’s Recognition Award (PRA) and credit system, a minimum performance level must be established on enduring material and journal-based CME activities that are certified for AMA PRA Category 1 Credit™. In order to successfully complete 2012 Pediatrics in Review articles for AMA PRA Category 1 Credit™, learners must demonstrate a minimum performance level of 60% or higher on this assessment, which measures achievement of the educational purpose and/or objectives of this activity.

Starting with 2012 Pediatrics in Review, AMA PRA Category 1 Credit™ can be claimed only if 60% or more of the questions are answered correctly. If you score less than 60% on the assessment, you will be given additional opportunities to answer questions until an overall 60% or greater score is achieved.

1. Which of the following conditions in neonates should prompt an immediate evaluation by a healthcare provider?
   A. Brick-colored crystals in the diaper.
   B. Failure to pass stool in the first 12 hours of life.
   C. Jaundice in the first 24 hours of life.
   D. Weight loss of 5% in the first week.
   E. White vaginal discharge.
2. You are counseling new parents on their son's care before his discharge at 2 days old. His newborn course has been normal except for some mild spitting up after feeds. The parents have opted not to have him circumcised before discharge. Which of the following is the best advice?
   A. He may have dextrose water between breastfeeding if he appears hungry.
   B. He should sleep on his abdomen because he has gastroesophageal reflux.
   C. They should apply daily antibiotic ointment to his umbilical stump.
   D. They should retract the foreskin daily to prevent infection.
   E. They should seek medical care immediately if he has a fever >100.4°F.

3. You are attending the caesarian delivery of a 39 weeks' gestation boy. Upon delivery, his heart rate is 90 beats per minute and he is breathing normally. He shows flexion of all extremities and has good muscle tone and a strong cry. His lips are pink but his hands and feet are bluish. What Apgar score would you assign at 1 minute?
   A. 6.
   B. 7.
   C. 8.
   D. 9.
   E. 10.

4. Which of the following statements regarding maternal and neonatal care is true?
   A. Apgar scores are assigned to predict neurologic development.
   B. Epidural anesthesia is associated with an increased risk of fetal bradycardia.
   C. Infants who are born via vaginal delivery have an increased risk of transient tachypnea of the newborn.
   D. Only infants who are exclusively breastfed require vitamin D supplementation.
   E. Pediatricians play a role in recognizing postpartum depression in mothers.

5. At a prenatal visit, a mother asks you about the effects breastfeeding might have on her own health. Which of the following would be a true consequence if she breastfeeds her baby?
   A. She is at higher risk for developing type 2 diabetes.
   B. She is less likely to develop ovarian cancer.
   C. She is likely to put on more weight.
   D. She is more likely to develop breast cancer.
   E. She will be at higher risk for becoming depressed.
Sexual Abuse

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Author Disclosure
Drs Fortin and Jenny have disclosed no financial relationships relevant to this article. This commentary does not contain a discussion of an unapproved/investigative use of a commercial product/device.

Objectives After completing this article, readers should be able to:

1. Understand the definition and epidemiology of sexual abuse.
2. Know when to suspect sexual abuse, and know which behaviors are normal and which are suggestive of abuse.
3. Recognize that a sexually transmitted disease may be an indicator of sexual abuse.
4. Be aware of the recommended methods for taking a history when there is concern about sexual abuse.
5. Know the proper techniques for examining a child when sexual abuse is possible, and how to interpret physical findings. Be aware that a normal physical examination does not rule out sexual abuse.
6. Be familiar with techniques for collecting forensic evidence and the value of laboratory testing.
7. Know the psychological and legal aspects of sexual abuse, and be aware of treatment plans and methods for prevention.

Introduction
It is almost certain that pediatricians will encounter child sexual abuse over the course of their careers. Sexual abuse is prevalent. Sexually abused children present for medical care in a variety of clinical contexts. The evaluation and treatment of child sexual abuse involves multidisciplinary collaboration. The health professional’s role includes addressing the physical and mental health consequences of abuse. Physicians are mandated to report suspected abuse to authorities.

In this article, history taking, physical examination, forensic evidence collection, laboratory testing, sexually transmitted infections (STIs), interpretation of clinical findings, psychosocial outcomes, legal considerations, and treatment will be discussed. Pediatricians might choose to consult with a health professional specializing in the management of child sexual abuse, depending on the clinical context, the physician’s level of ease with components of the evaluation, and local resources.

Background Information
Child sexual abuse occurs when a child is engaged in a sexual situation. Some cases of sexual abuse involve physical contact between the victim and the perpetrator, with or without oral, anal, or vaginal penetration. In other cases, there is no touching (eg, a child is made to watch sexual acts or pornography). In the majority of cases, perpetrators are not strangers, but are known to the victim through relationships such as being relatives, family friends, neighbors, or community volunteers. (1)(2)(3) In many instances, perpetrators “groom” their victims and use threats, manipulation, or coercion as opposed to physical force. (2)(3) Delay between the onset of abuse and disclosure is common. Adults surveyed about past experiences of child sexual abuse often report that they did not tell anyone about their abuse during childhood. (4)(5) One study found that approximately one-quarter of sexual abuse victims retract their statements of abuse at some point, (6) and recantation does not rule out sexual abuse.

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Epidemiology

Measures of sexual abuse frequency vary, depending on factors such as data source, definition of sexual victimization, and study population. The 2005–2006 National Incidence Study found that the incidence of sexual abuse cases that came to the attention of investigators or other community professionals was 2.4/1,000 US children under the age of 18 years. (7) A 2005 telephone survey of children and caregivers by Finkelhor et al evaluated the frequency of sexual victimization in a nationally representative sample of children in the United States. Overall, 82/1,000 (1 in 12) children aged 2 to 17 years experienced sexual victimization such as sexual assault, sexual harassment, or flashing in the study year, including 67/1,000 boys, 96/1,000 girls, and 168/1,000 teenagers. (8)

Other studies have estimated the frequency of child sexual abuse by asking adults about their childhood experiences. A frequently cited Los Angeles Times survey found that 27% of women and 16% of men reported childhood sexual abuse. (4) Because it is not possible to account for undisclosed cases of sexual abuse, measures of frequency probably underestimate the true scope of child sexual abuse.

As reflected by these data, sexual victimization is more common among girls than among boys. Boys, however, might be less likely to disclose sexual abuse and might be victimized more often than the reported gender ratios suggest. Compared with other age groups, teenagers have the highest rates of sexual assault. (9) Physical disabilities, prior sexual victimization, and absence of a protective parent are other potential risk factors. (1)(2)(9)(10)

Clinical Presentation

Health professionals caring for children can encounter instances of child sexual abuse in different contexts. Patients sometimes present for evaluation soon after an episode of suspected abuse. In many cases, however, disclosures of sexual abuse are delayed, and therefore medical attention is sought outside of the acute period. Some patients are brought to medical attention by way of involvement with community agencies such as child protective services or law enforcement agencies. In other cases, victims and their families turn to health care providers first.

Disclosure of sexual abuse generally leads to a medical evaluation. Children present after they have made a statement of abuse to a professional, such as a social worker, teacher, or law enforcement agent, or to a nonprofessional such as a parent or a friend.

Concern for sexual abuse also can be raised in children who have not disclosed abuse. Sexual abuse enters the differential diagnosis when children exhibit worrisome sexual behaviors. Sexual behavior problems must be differentiated from developmentally normal behaviors. Examples of normal behaviors in preschool-aged children include undressing in front of others, touching one’s own genitals, and trying to look at others undressing. Research, including Freidrich et al’s study of >800 children, has shown that transient, developmentally appropriate behaviors are common among children who have not been sexually abused. (11)(12) The pediatrician can reassure parents in cases of developmentally appropriate, transient behaviors.

In contrast, behaviors such as coercing others to engage in sexual acts or explicitly imitating intercourse are uncommon and warrant comprehensive evaluation. (11)(12) Children who have sexualized behavior problems may engage siblings or peers in sexual acts; immediate intervention is required to ensure that all children involved are protected. No behavior is in and of itself diagnostic of sexual abuse. The differential diagnosis for sexual behavior problems also includes exposure to violence in the home, emotional abuse, neglect, conduct disorder, witnessing sexual acts, and exposure to sexual materials. Community resources, including mental health professionals and pediatric subspecialists in child abuse pediatrics, can assist pediatricians in evaluating sexual behaviors. A 2009 clinical report issued by the American Academy of Pediatrics (AAP) discusses childhood sexual behaviors in detail. (12)

A study of 112 children aged 3 to 7 years found that children with a sexual abuse history were more likely to include genitalia in their drawings in comparison with controls. (13) It is important to note that, although drawing of genitalia raises concern for sexual abuse, it is not diagnostic of sexual abuse in and of itself.

Sexually abused children also can present with nonspecific physical or emotional complaints, such as unexplained abdominal pain, genital pain, encopresis, school failure, or sleep disturbance. The vast differential diagnoses for these nonspecific presenting complaints include both organic pathology and a range of psychological stressors. When concern is raised for sexual abuse because of a non-specific presenting complaint, questioning about stressors, including abuse, should be conducted in an open-ended, nonleading, developmentally appropriate manner. Nonspecific symptoms in isolation are not diagnostic of sexual abuse.

In rare cases, specific medical findings will be the initial indication that sexual abuse has occurred. The presence...
of sperm in a sample taken directly from a child’s body and pregnancy are examples of medical findings that are diagnostic of sexual contact. (14)

**Overview of the Medical Management of Child Sexual Abuse**

As with medical evaluations for other pediatric complaints, components of medical evaluations for sexual abuse include history taking, physical examination, laboratory testing, and treatment planning. In addition, forensic evidence collection is indicated in some cases; in all cases, physicians are mandated to report suspected child abuse to the proper authorities in their jurisdiction.

There are many variables to consider when patients present for evaluation of sexual abuse, such as patient age and timing since the last episode of suspected abuse. Medical evaluations are tailored to the given context to ensure comprehensive evaluation and intervention. For example, there will be significant differences between the evaluation of a teenage victim of acute sexual assault and that of a preschooler who disclosed sexual abuse occurring 1 month ago. Specialists with training and experience in the management of child sexual abuse can provide consultation.

**Medical History Taking**

The medical history is often the most important part of a sexual abuse evaluation. Objectives in obtaining the medical history include:

1. Gather information needed to guide the medical evaluation (eg, determine the need for forensic evidence collection or testing for STIs).
2. Gather information needed to establish a medical treatment plan (eg, determine if postexposure prophylaxis is indicated).
3. Detect physical health symptoms related to abuse that require further evaluation and treatment.
4. Detect psychological sequelae of abuse.
5. Identify familial psychosocial consequences of abuse (eg, parental emotional distress, financial concerns).
6. Detect medical problems that are not directly related to the alleged abuse.
7. Assess the immediate safety of the child.

Potential sources of information include other professionals, the child’s caretakers, and the child. Caretakers who accompany the child to the medical evaluation should be supportive, and suspected perpetrators of abuse should not be present. In the absence of extenuating circumstances (eg, child refuses to separate from the caregiver), information sources should be interviewed separately.

**Taking a History From Caretakers**

In cases in which the patient made a statement of abuse before the evaluation, caretakers can be asked about the child’s disclosure. Information about the timing and nature of the suspected abuse is important for making decisions about STI testing, prophylactic treatments, and forensic evidence collection. Information provided about the alleged perpetrator, such as known health problems, history of intravenous drug use, and history of incarceration, is useful in assessing the patient’s risk for STIs. Asking about ongoing contact between the alleged perpetrator and the patient or other children is important in assessing child safety.

On review of systems, a report of dysuria or anogenital pain, bleeding, discharge, or itching could be indicative of infection or injury. Any history of constipation, enuresis, and encopresis also should be reviewed. Age of menarche and date of last menstrual period are pertinent to the assessment of pubertal development, symptoms of pregnancy, and the possibility of menstrual bleeding during physical examination. It is important to conduct a review of psychological and behavioral symptoms. In some cases, patients have symptoms such as suicidal ideation that require immediate mental health intervention. Reports of school failure, sleep disorders, sexually reactive behaviors, nightmares, anxiety, or depression require appropriate referrals and intervention. A history of other abusive or consensual sexual activity should be obtained.

Child sexual abuse also has an impact on the patient’s family. (15) In obtaining a social history, it is important to identify household members. Child protective services can collaborate to determine if other children in the home have been witnesses or victims of abuse. Financial concerns might be raised in cases where the alleged perpetrator was previously a financially contributing household member. The caretakers’ response to a child’s disclosure of sexual abuse is important. Asking about caretakers’ emotional state and support systems can be helpful in optimizing services for the family. Significant concerns for child safety are raised when a caretaker is openly disbelieving of a child’s disclosure and when a caretaker allows further contact between a child and the suspected perpetrator of abuse.

**Taking Histories From Children**

Children’s statements about abuse are a key component of most sexual abuse investigations. There is a breadth of information on obtaining accurate and comprehensive
histories from children suspected of being victims of abuse. Resources include practice guidelines from professional organizations such as the American Professional Society of the Abuse of Children, textbooks, and a growing body of research. (16)(17)(18)

General considerations in asking children questions about abuse include the types of questions asked, the patient’s developmental level, and the number of interviews. Open-ended questions and questions that invite narrative responses are preferred. Examples include, “Tell me why you came to see the doctor today,” and “Tell me everything that happened.” Questions that suggest an answer, such as, “Your uncle touched you, right?” are to be avoided. Compared with adults, children under the age of 10 to 12 years are more suggestible. Children as young as 3 or 4 can provide accurate accounts when questioned properly. Some interviewers may use human figure drawings or free drawings to help build rapport and collect information. Most professional interviewers usually do not interview children under the age of 3 years, depending on the child’s level of language development. Children should be interviewed separately from their caretakers in the absence of extenuating circumstances.

Avoid interviewing a child multiple times unnecessarily. In many communities, children’s advocacy centers coordinate community agencies and professionals to minimize the number of interviews. The first was established in Huntsville, Alabama, in 1985. There are now >700 children’s advocacy centers in the United States offering a multitude of services. Further information and center locations can be found at http://www.nationalchildrensalliance.org.

Professionals with specialized knowledge, such as child protective services investigators, trained forensic interviewers, or law enforcement officers, conduct investigative interviews. This action does not exclude health providers from obtaining medical history for the purposes of medical evaluation and treatment planning. Physical, behavioral, and psychological symptoms as outlined above can be reviewed with patients when developmentally appropriate. In some instances, children make spontaneous statements about abuse in the course of a medical visit. These statements should be documented carefully in the medical record.

In many jurisdictions, forensic interviews are video- or audio-taped. In many medical settings, however, audio-visual recording is not feasible nor is it common practice, and written documentation is used. Written documentation of children’s statements about abuse should contain the questions asked in addition to the child’s responses. The child’s exact words in quotations should be included where possible.

Professional interviewers sometimes use media such as anatomic drawings or anatomic dolls. (17)(19) Anatomic dolls have genitalia, anal and mouth openings, and developmentally appropriate secondary sex characteristics. The use of anatomic dolls has given rise to academic and legal debate. One of the main challenges to the use of anatomic dolls is concern for suggestibility. On the other hand, research studies demonstrate that anatomic dolls can be used nonsuggestively and may enhance children’s ability to describe an abusive event. The use of anatomic dolls should be reserved for professionals with specialized training in interviewing.

Physical Examination

Objectives

Objectives of the physical examination completed in the context of a sexual abuse evaluation include:

1. Recognize injuries that require immediate medical attention.
2. Identify anogenital abnormalities, including conditions that mimic injuries (eg, lichen sclerosis), and interpret physical findings appropriately (eg, normal variant, nonspecific, indeterminate, indicative of trauma).
3. Detect signs of STI.
4. Identify injuries outside of the anogenital region (eg, mouth, chest, extremities).
5. Recognize signs of self-injurious behaviors (eg, scars from cutting).
6. Address patient concerns about physical health that may arise subsequent to abuse.
7. Collect forensic evidence.

Comprehensive Examination

Physical examination in the context of a sexual abuse evaluation is not limited to the anogenital region. A comprehensive head to toe examination is indicated. Victims of sexual assault can sustain physical injuries outside of the anogenital region. Some injuries require immediate medical attention (eg, uncontrolled bleeding, injury to the airway or viscera). The oral cavity should be examined carefully for signs of injury to the teeth and soft tissues. Skin injuries such as bruises and bite marks should be identified and documented carefully. When possible, photographing findings is helpful. Psychological symptoms can manifest physically in the form of sequelae from self-mutilating behaviors, such as cutting. In addition, a 2006 study by Giradet et al demonstrated that health problems unrelated to sexual assault, such as dental caries, decreased visual acuity, pediculosis, tinea, heart murmurs,
and otitis media, were identified frequently in the course of sexual assault evaluations. (20)

A Normal Examination Does Not Rule Out Sexual Abuse

A normal physical examination does not exclude the possibility of sexual abuse or prior penetration. The majority of sexual abuse victims have normal anogenital examinations. Multiple research studies demonstrate a low prevalence of definitive physical findings among victims of sexual abuse. (21)(22)(23)(24) In a case control study of close to 400 prepubertal children, Berenson et al found that, in the majority of cases, genital examinations did not differ between sexually abused children and controls. Physical findings specific to previous genital trauma were found in only 2.5% of abused children. (23) Kellogg et al studied a cohort of 36 pregnant adolescents who underwent sexual abuse evaluations. Only 5.5% of the pregnant teenagers had definitive findings of penetration on genital examination. (24)

Reasons for the absence of definitive physical findings subsequent to sexual abuse include:

1. With some forms of abuse, sexual victimization would not be expected to result in injury.
   Some forms of sexual victimization, such as exhibitionism and voyeurism, do not involve physical contact between the perpetrator and the victim. It follows that there is no resultant physical injury. In some cases, children are solicited to touch the perpetrator's genitals, another example of sexual abuse occurring without anogenital injury to the victim. Genital fondling or oral contact to body parts can occur without tissue damage.
   Furthermore, penetration of the genitalia includes not only penetration of the vagina but also penetration between the labia. Penetration of the labia without penetration of the hymen will not result in hymenal tearing.

2. Penetrated tissues are sometimes stretched without injury.
   Hymenal and anal tissues have the ability to stretch. Although it is a common misconception that the hymen is always damaged at coitarche, in actuality, the hymen can remain undamaged after penetration. The anus also has the ability to stretch and remain uninjured subsequent to penetration.

3. Injuries can heal by the time of the medical evaluation.
   Mucosal and epithelial tissues can heal rapidly between sexual victimization and disclosure of abuse. (25)(26) McCann et al studied the healing of hymenal injuries and found that hymenal petechiae resolved within 48 to 72 hours. (26)

In some instances, caregivers believe that a physical examination will determine if their child has been sexually abused. Patients, jurors, and nonmedical professionals may share this misconception as well. It is important to communicate that a normal examination does not rule out sexual abuse, and that the majority of sexually abused children do not have specific anogenital examination findings proving they were abused.

Anogenital Examination

Physical examination should not cause added trauma. Explanations to parents and the child before, during, and after the examination can ease stress. Supportive, nonoffending caretakers also can be comforting to the child. Older patients can indicate if they prefer to undergo the examination with or without their caretaker in the examination room. The AAP Committee on Practice and Ambulatory Medicine has published guidelines on the use of chaperones during the examination of pediatric patients. (27) Suspected perpetrators should never be present. Patients who refuse should not be forced to undergo an examination. The use of sedation is not routine practice but can be considered in rare cases where the examination is vital (example, active vaginal bleeding) and where the patient cannot tolerate the examination without it.

The physical examination can have a positive psychological impact on patients. Victims of sexual abuse often fear their bodies have been damaged by abuse and are relieved to learn that they are in good health. Mears et al studied adolescents' responses to sexual abuse evaluations and found that, whereas some found the examination embarrassing or painful, the majority (78.9%) agreed that the examination helped them to feel better. (28)

When examining girls, it is important to know the appropriate terminology for the genital structures. Figure 1 shows names of common structures of the prepubertal introitus.

Gender, age, and pubertal stage influence examination procedures. In girls, estrogen influences hymenal morphology. In the newborn period, the hymen appears thick and redundant under the influence of maternal estrogen. The hymen changes in morphology during the first years of life. (29) The unestrogenized prepubertal hymen appears thin, more translucent, and redder in color, and vasculature can be visible (Fig 2). After pubertal estrogenization, the hymen appears thicker, paler, and redundant (Fig 3). It is important to recognize physiologic differences in hymenal morphology during childhood and adolescence.
Some examination techniques involve contact with the hymen. For example, moistened swabs can be used to unfold the hymen to visualize the hymenal rim. Prepubertal patients are unable to tolerate such techniques because the hymen is very sensitive to touch during this period of development. Likewise, prepubertal patients would not tolerate speculum examinations. In the rare cases in which an internal examination is required in a prepubertal child (eg, uncontrolled vaginal bleeding, foreign body), examination with a speculum or vaginoscopy should be performed under anesthesia.

Different examination positions and techniques can be used to examine vestibular structures. The supine lithotomy position can be used for patients who are older and taller, whereas the supine frog leg position depicted in Fig 4 is used commonly in prepubertal patients. The frog leg position also can be attempted with the patient on the caregiver’s lap; this technique is useful when children are reluctant to get on the examination table. The external surface of the labia majora will be visible when patients are in the examination position. Separation and traction of the labia majora allow for visualization of the vestibular structures. In some instances, the hymenal opening is not readily visible. Adjusting labial traction may facilitate visualization of the hymenal rim. Also, dropping a small amount of normal saline in the vestibule while the patient is in the supine frog-leg position can lead to unfolding of the hymenal edges and improved visualization.

When an abnormality such as a hymenal transection is suspected, an alternate position or technique should be used to confirm the finding. In prepubertal patients, the prone knee-chest position can be used (Fig 4). In pubertal patients, moistened cotton swabs or Foley catheters can be used to unfold the hymen and visualize the posterior rim. Specialists with experience in using these techniques can provide consultation. Colposcopes provide magnification and lighting. In addition, colposcopy often allows for still or video recording of the examination. The colposcope does not come into contact with the patient, and this fact should be explained to children and parents.

Figure 1 depicts normal prepubertal female anatomy. Examination of the female external genitalia includes Tanner (sexual maturity) staging. The labia majora and minora should be evaluated for signs of trauma such as bruising or abrasions. Clitoromegaly should be addressed if it is noted. The urethral meatus should be assessed for discharge or prolapse. The hymen should be examined. When describing the hymen, it is useful to imagine...
a superimposed clock with the 12 o’clock position located anteriorly and the 6 o’clock position located posteriorly. Any irregularities can be described with respect to their position on the clock. The normal hymen can have a variety of configurations; crescentic (hymenal tissue not visible between the 11 and 1 o’clock positions) and annular (presence of circumferential hymenal tissue) configurations are common. Bleeding, discharge, or other abnormalities at the vaginal opening should be assessed. The fossa navicularis, posterior fourchette, and perineal body also should be evaluated.

Examination of the male external genitalia includes evaluation of Tanner stage, glans, and shaft of the penis, urethral meatus, scrotum, and perineum. Injuries such as bruises and bite marks should be noted. Discharge, inguinal adenopathy, and any other abnormality should be addressed as well.

Examination positions for the external anal examination include supine knee–chest and lateral decubitus. Any lesions, scars, or other abnormalities should be noted. Anal findings specific to sexual abuse (e.g., acute laceration not attributed to accidental injury, scar not attributed to medical condition or accidental injury) are not prevalent. Common findings that are not specific to sexual abuse include perianal redness, fissures, and venous congestion or pooling. The latter can be caused by being in the examination position for a prolonged period of time. Digital rectal examination is not indicated routinely.

**Interpretation of Examination Findings**

When present, medical findings indicative of sexual abuse are significant in criminal investigations, child protection investigations, and courtroom proceedings. In addition, anogenital findings affect medical decisions. For example, genital tract trauma is a risk factor for human immunodeficiency virus (HIV) transmission and can factor into the decision to initiate postexposure prophylaxis after acute sexual assault. Physical findings must be interpreted accurately. Health professionals with expertise in the evaluation of sexual abuse can provide consultation. Findings that are definitively indicative of previous trauma and those that are normal variants or nonspecific to sexual abuse must be differentiated. Research studies by authors such as Adams et al, Berenson et al, and McCann et al...
provide an evidence base for interpreting physical findings. (14)(23)(30) The 2007 article by Adams et al includes a table classifying findings into categories such as:

1. Normal variants (eg, periurethral bands, hymenal tags, shallow hymenal notch, anal skin tag, perianal venous pooling).
2. Findings common to other medical conditions (eg, genital or perianal erythema, labial adhesions, infections such as group A Streptococcus, lichen sclerosis, eczema, anal fissures).
3. Indeterminate findings, in which there are insufficient data to determine definitively the significance of these findings in and of themselves (eg, deep notch or cleft in the posterior rim of the hymen, genital verrucous lesions).
4. Findings indicative of trauma (eg, laceration or bruising of the hymen, genital or perianal bruising, hymenal transections).
5. Findings diagnostic of sexual contact (eg, pregnancy, sperm on a specimen taken directly from patient’s body).

The diameter of the hymenal opening can be influenced by factors such as patient relaxation or labial traction and is not diagnostic of sexual abuse.

The AAP publishes an excellent resource for physicians that explains normal and abnormal genital findings in children, including medical conditions that can mimic trauma. (31)

Forensic Evidence Collection

Another misconception about sexual abuse evaluations held by some families and jurors is that forensic evidence is always present. Given that victims often delay disclosing sexual abuse for days, weeks, or years, it is not possible even to attempt forensic evidence collection in many cases. Furthermore, forensic evidence collection does not always lead to positive results, even when victims present within 72 hours. In a retrospective review, Christian et al found that forensic evidence was identified in one-quarter of prepubertal patients who underwent evidence collection. (32) As with physical findings, forensic evidence is not required to make a diagnosis of child sexual abuse.

Timing and nature of the disclosed abuse are important considerations when determining whether forensic evidence collection is indicated. In most jurisdictions, forensic evidence collection is required if abuse involving the exchange of bodily fluids occurred within 72 hours. This time interval varies by state. It is noteworthy that forensic evidence rarely is found on swabs collected from the bodies of prepubertal children after 24 hours. In Christian et al’s study of prepubertal patients, forensic evidence was more likely to be collected from clothes and household objects, such as sheets and towels, than from a child’s body. (32) No swabs taken from prepuberal patients’ bodies were positive for semen after 9 hours. (32) Blood, hair, semen or sperm, skin (which can be lodged under patients’ fingernails after scratching the alleged perpetrator), trace evidence such as fibers or debris, and saliva are examples of forensic findings. It is important to consider if the disclosed abuse could potentially result in forensic findings. For example, fondling over clothes does not involve contact with the alleged perpetrator’s semen, blood, or saliva.

Standardized forensic evidence collection kits typically include a container that will be identified with patient information, forms (eg, authorization forms, medical history forms), designated swabs and smears (vaginal or penile, anal, and oral), body swabs (for secretions, debris, or bite marks), test for DNA comparison (blood, saliva, or buccal sample), collection bags (for underwear, clothing, and debris), collection materials for pubic hair combings, and collection materials for fingernail scrapings. Instructions for collecting, drying, labeling, packaging, and sealing samples usually are included in the kit. Not all components of the kit will be applicable to every patient. For example, pubic hair combings are not applicable to patients who do not have pubic hair. Examiners should wear gloves. Local chain-of-evidence protocols, including transfer and storage of evidence kits, should be followed.

Laboratory Testing

As with other medical conditions, decisions about laboratory testing for sexually abused children are based on clinical data. Testing for STIs, pregnancy, and drug-facilitated abuse sometimes are indicated.

STIs

Approximately 5% of sexually abused children contract an STI from abuse. (12)(33) Thoughtful utilization of laboratory studies will maximize STI detection and minimize unnecessary testing. Clinicians must determine not only whether STI testing is indicated, but also which studies should be performed and how the tests should be timed. The following factors influence decision-making:

1. Characteristics of the disclosed abuse

   a. Type of sexual contact: Digital-genital contact would not increase the patient’s risk for STIs such as HIV, Chlamydia infection, or gonorrhea. Rectal swabs for Chlamydia and gonorrhea should be
considered when there has been a disclosure of receptive genital-anal contact.

b. Timing of the abuse: In addition to testing at the time of initial presentation, patients require repeat testing in cases in which the last episode of abuse was recent. For example, convalescent testing for syphilis and HIV are indicated at 6, 12, and 24 weeks’ postassault. Repeat Chlamydia and gonorrhea testing ~2 weeks after the last contact is indicated in cases in which prophylactic treatment was not given. (33)(34)

2. Perpetrator characteristics: Known history of STI, risk factors for STI such as multiple sexual partners.

3. Community prevalence of STI

4. Clinical findings
   a. Symptoms or signs of STI
   b. Physical findings indicative of penetrating trauma
   c. Family history of STI

5. Patients requesting testing or having a high level of concern for STI

   Available tests include serologic studies for HIV, syphilis, and hepatitis B. Wet mounts and other studies of vaginal discharge can identify Trichomonas vaginalis and bacterial vaginosis. Polymerase chain reaction testing or culture of genital lesions can test for herpes simplex virus. Specimens from the rectum, male urethra, vagina, and urine can be tested for Chlamydia trachomatis and Neisseria gonorrhoeae. Throat specimens also can be tested for gonorrhoeae. (33) Recent studies of chlamydia and gonorrhea infections in sexually abused children compared gold standard culture techniques to the newer nucleic acid amplification tests (NAATs). (35)(36) An important advantage of NAATs is that they can be performed on urine samples, thus providing a less invasive testing option. Positive NAAT results can be confirmed by tests that target a different nucleic acid sequence. It is important to ensure that tests used in the context of forensic evaluations are specific. Clinicians should review local testing procedures with child abuse and microbiology specialists.

   Just as it is important to interpret physical findings accurately, providers must be aware of the forensic implications of STI. (14)(37) The following are facts to consider when a prepubertal child is diagnosed as having an STI. (33)(37)

1. Confirmed trachomatis, gonorrhea, and syphilis are diagnostic of sexual abuse when perinatal and rare nonsexual transmission are excluded.

2. HIV infection is diagnostic of abuse when perinatal transmission or transmission from transfusions or needle sticks are excluded.

3. Vaginalis infection is highly suspicious for sexual abuse.

4. Bacterial vaginosis can be unrelated to sexual abuse.

5. Anogenital warts (condyloma acuminata) and genital herpes simplex are suspicious findings. Anogenital warts can be transmitted sexually. There are other modes of transmission, however, including autoinoculation, nonsexual fomite transmission, and vertical transmission. Although anogenital warts raise suspicion for sexual abuse, they are not diagnostic of abuse.

**Pregnancy**

Pregnancy testing should be performed where indicated based on the patient’s pubertal stage and disclosure. A negative result should be ensured before administration of emergency contraception.

**Drug-Facilitated Abuse**

In some cases, perpetrators use drugs such as alcohol, flunitrazepam, y-hydroxybutyrate, ketamine, benzodiazepines, and antihistamines to facilitate sexual assault. (9) Substances such as flunitrazepam can go undetected when added to a drink. Victims may be unaware that they are being drugged. Symptoms of drug ingestion include somnolence, amnesia, dizziness, and visual disturbances. These drugs are detectable in blood or urine for short periods of time (<12–72 hours). These drugs are not included in routine drug screens. Local resources can guide specimen collection and inform clinicians about available testing procedures.

**Psychosocial Outcomes**

Child sexual abuse is associated with a multitude of negative psychological and social outcomes. Negative outcomes are not limited to childhood and also have been demonstrated among adult survivors. Victims are at increased risk for sequelae such as depression, anxiety, posttraumatic stress disorder, sexualized behaviors, suicide attempts, substance abuse, eating disorders, sleep disturbances, personality disorders, somatization, early pregnancy, school failure, and repeat victimization. (1)(38)(39)

Early detection of psychological sequelae and prompt initiation of treatment are important. In some cases, psychological symptoms are not present initially, but develop over time. It is important to review psychological symptoms not only during the initial evaluation but also on follow-up visits.

Nonoffending caregivers also can experience negative psychosocial consequences. In the majority of cases, the family knows the perpetrator. Nonoffending caregivers
lose relationships in the course of protecting their children. Ending relationships can result in financial strain and housing concerns when the perpetrator was previously a financially contributing household member. Caregivers also may experience negative psychological outcomes such as depression, reliving of previous abuse experiences, and relapses of substance abuse.

Nonoffending caregivers’ responses to sexual abuse affect children’s well being. (40) Caregiver support has been associated with positive emotional and behavioral outcomes among abused children. The importance of the caregivers’ roles in supporting child victims should be reinforced. On the other hand, nonprotective caregivers who allow ongoing contact with the alleged perpetrator place children at risk for revictimization and significant psychological harm. Clinicians should report such concerns for child safety to child protective agencies.

Legal Considerations
In the United States, physicians are required by law to report child abuse. (37) Health providers are mandated to report not only confirmed cases, but also cases where there is reasonable cause to suspect abuse. A summary of state laws and procedures for reporting suspected child abuse can be found at http://www.childwelfare.gov/systemwide/laws%5Fpolicies/.

In many states, a report to both the local child protection agency and law enforcement is required for cases of suspected sexual abuse. Failure to report a case of abuse places the patient and possibly other children at risk for harm. In addition, mandated reporters who fail to report child abuse can face legal ramifications and malpractice actions. As detailed in an AAP policy statement, Health Insurance Portability and Accountability Act (HIPPA) rules do not apply where state laws provide for reporting child abuse. (41) Professionals who make a report of child abuse in good faith are immune from liability by statutes in each state. In some cases, pediatricians question whether a report is indicated. Local child protection agencies and child abuse specialists can be contacted to discuss cases. Examples of scenarios that would not involve a mandated report include isolated nonspecific behavioral symptoms (eg, enuresis, aggression) or isolated nonspecific physical signs such as labial adhesions or vaginal irritation.

Another legal issue that might arise in evaluating patients for sexual abuse is involvement in criminal, juvenile, civil, or family court proceedings. There are different types of court proceedings and different types of witnesses. Some court proceedings involve criminal prosecution, whereas others concern custody of the child. Physicians are asked to testify as fact witnesses or as expert witnesses. Fact witnesses restrict their testimony to the facts of the case, but expert witnesses can provide interpretation and opinion. As discussed in the AAP statement on expert witness participation in civil and criminal proceedings, the new subspecialty of child abuse pediatrics sets high standards for professional conduct in expert witness testimony. Physicians who feel uncomfortable testifying as an expert in cases of child abuse and neglect should consider consultation with a specialist. (42)

Treatment
Treatment plans address physical health, mental health, child safety, and psychosocial concerns. Physicians can prescribe prophylactic medications in some clinical situations. (33) Baseline STI and pregnancy testing should be completed before prophylactic treatment. Prophylactic antibiotics can be used to prevent gonorrhea, Chlamydia infection, Trichomonas infection, and bacterial vaginosis among patients who present within 72 hours of an assault that could potentially result in STI transmission. These prophylactic antibiotics generally are not prescribed for prepubertal patients because, in this age group, the incidence of STI is low, patients are not at high risk for infection to spread to the upper genital tract, and it is generally possible to ensure follow-up testing. (33)

HIV postexposure prophylaxis involves a 28-day course of a two to three drug regimen initiated as soon as possible within 72 hours of potential exposure, and careful follow-up, as well. Risk factors for HIV transmission that might be identified on clinical evaluation include a perpetrator with known or suspected HIV infection, genital tract injury, receptive anal intercourse, absence of condom use, perpetrator with genital ulcer or other STI, and local infection at the exposure site. As detailed in an AAP clinical report, the decision to initiate HIV postexposure prophylaxis involves a careful risk benefit analysis. (43)(44) Table 1 lists options for prophylactic treatment of STIs among adolescents as recommended by the Centers for Disease Control and Prevention. (34)

Emergency contraception should be offered when female pubertal patients present within 72 hours of an assault that could potentially lead to pregnancy. (44) Pregnancy testing should be conducted before treatment. Because nausea is a common adverse effect of emergency contraception, prescription of an antiemetic should be considered. (33)(45) Formulation of hormonal medications, mechanism of action, timing, adverse effects, follow-up, and other considerations are discussed in detail in an AAP policy statement. (45)
Treatment planning also should address the potential mental health consequences of sexual abuse. In some cases, urgent psychiatric referral is indicated (eg, current suicidal ideation). In addition to mental health referrals for patients, counseling services for nonoffending parents often are indicated. Community resources can be activated to help families with social stressors such as housing and financial concerns that arise subsequent to a disclosure of abuse.

Physical and mental health symptoms as well as social stressors should be reevaluated on follow-up visits. In many cases, repeat testing for STI is indicated.

Timing of the Evaluation
When families contact pediatricians about situations of abuse, the need for urgent medical care versus a nonurgent appointment must be assessed. In some instances, urgent medical attention is indicated to treat or prevent health problems, address injuries, ensure safety, or perform forensic evidence collection. In cases in which urgent care is not required, however, scheduling an appointment will allow for nonrepetitive, comprehensive evaluation in a child-friendly setting. Physicians should be aware of local resources for medical evaluation of sexual abuse. Indications for urgent evaluation include, but are not limited to, situations in which:

1. The patient may benefit from prophylactic medical treatment as detailed above.
2. Clinical information is suggestive of anogenital injury (eg, report of injury, anogenital bleeding, or pain).
3. There is a possibility that forensic evidence may be collected (alleged abuse occurred within 72 hours and may involve transfer of biologic material).
4. An urgent child protection response is required (eg, child is not protected from alleged perpetrator or does not have a protective nonoffending caregiver).
5. There is report of an injury or symptom that may require urgent medical treatment.
6. There is report of a symptom that may require urgent mental health evaluation (eg, suicidal ideation).

Prevention
Many sexual abuse prevention programs focus on educating children about safety, appropriate and inappropriate touches, and telling an adult about abusive experiences. Parent education programs are being researched. (46) Technological developments have created a need for campaigns targeting Internet safety. The AAP clinical report on the impact of social media on children addresses healthy Internet use. (47)

Summary
- Child sexual abuse is a common pediatric problem that concerns all pediatric health care providers.
- Management of child sexual abuse is multifaceted and multidisciplinary.
- Specialized health providers can provide consultation, but this availability does not minimize the role of the referring physician who often has ongoing contact with the family.
- Physicians are mandated to report cases of suspected or confirmed sexual abuse.
- In the majority of cases, a child’s statement about sexual abuse is the strongest evidence that abuse has occurred.
• Physical examination is normal in the majority of sexual abuse victims.
• Accurate, evidence-based interpretation of physical and laboratory findings is essential. Normal examinations, normal variants, and findings indicative of sexual contact must be differentiated.
• Forensic evidence collection and prophylactic treatments may be indicated when patients present within 72 hours of an abusive episode, and patients should be triaged accordingly.
• Potentially negative psychosocial outcomes should be addressed for patients and their families on initial evaluation and follow-up.

References


Parent Resources From the AAP at HealthyChildren.org

The reader is likely to find material to share with parents that is relevant to this article by visiting this link: http://www.healthychildren.org/English/safety-prevention/at-home/pages/sexual-abuse.aspx.

PIR Quiz

Quiz also available online at http://www.pedsinreview.aappublications.org. NOTE: Beginning with this issue, learners can take Pediatrics in Review quizzes and claim credit online only. No paper answer form will be printed in the journal.

New minimum performance level requirements

Per the 2010 revision of the American Medical Association (AMA) Physician’s Recognition Award (PRA) and credit system, a minimum performance level must be established on enduring material and journal-based CME activities that are certified for AMA PRA Category 1 Credit™. In order to successfully complete 2012 Pediatrics in Review articles for AMA PRA Category 1 Credit™, learners must demonstrate a minimum performance level of 60% or higher on this assessment, which measures achievement of the educational purpose and/or objectives of this activity.

Starting with 2012 Pediatrics in Review, AMA PRA Category 1 Credit™ can be claimed only if 60% or more of the questions are answered correctly. If you score less than 60% on the assessment, you will be given additional opportunities to answer questions until an overall 60% or greater score is achieved.

6. Among the following reported behaviors, the one most suspicious for sexual abuse of a 4-year-old child is:
   A. Humping classmates at preschool.
   B. Running around the home nude at bath time.
   C. Periodic touching of his or her own genitalia while at home.
   D. Taking off underwear in preschool.
   E. Trying to observe a parent undressing.
7. You suspect that a 5-year-old girl has been sexually abused. Confirmation of the diagnosis is most likely to come from:
   A. Appropriate interview of the child.
   B. Forensic evidence.
   C. Parental reports.
   D. Physical examination of the genitalia.
   E. Vaginal culture.

8. The most reliable way to conduct an interview with a 5-year-old child who claims her stepfather has sexually abused her is to:
   A. Assure that several interviewers obtain consistent results.
   B. Insist that the interview be videotaped.
   C. Interview the girl with her mother present.
   D. Simply invite the child to tell her story without specific prompting.
   E. Use anatomically correct dolls routinely.

9. Although the majority of sexually abused girls have normal findings on examination of the genitalia, in some cases, there are findings indicative of trauma. The examination finding that is most strongly indicative of sexual abuse in a 6-year-old girl is:
   A. A periurethral band.
   B. Anal skin tag.
   C. Bruising of the labia minora.
   D. Labial adhesions.
   E. Perianal warts.

10. An 8-year-old girl reports chronic sexual abuse by her mother’s boyfriend. Which of the following results of the physical examination and laboratory tests is most specific for the diagnosis of sexual abuse?
    A. Herpetic lesion on her lower lip.
    B. Two perianal warts.
    C. Urine nucleic acid amplification test positive for *Chlamydia trachomatis*.
    D. Wet mount positive for *Gardnerella vaginalis*.
    E. Wet mount positive for *Trichomonas vaginalis*. 
Obstetric Conflict: When Fetal and Maternal Interests Are at Odds

Susan F. Townsend, MD, FAAP*

Introduction
Emerging therapies today offer the promise of treatment for “fetal patients.” Because of this focus, fetal interests have increasingly been considered separately from maternal interests by clinicians, policy makers, and the bioethics community. Nonetheless, pregnancy creates a unique circumstance in medical ethics because the fetus can be accessed only through intervention on the pregnant woman. Although maternal and fetal interests usually are aligned, care of the fetus is intertwined with and dependent on care of the pregnant woman, and at times conflict can arise between fetal and maternal interests. This circumstance is termed “obstetric” or “maternal-fetal” conflict. These are emotionally laden issues that involve protecting the rights of women and the best interests of the fetus. This review will outline some ethical constructs that may be used to help resolve such conflicts.

Ethical Frameworks Used to Resolve Obstetric Conflicts
When conflict arises between maternal and fetal interests (eg, refusing a cesarean delivery for fetal distress, or treatment of cancer during pregnancy that could result in fetal death), more than one ethical theory may be useful to aid decision-making. (1) Principle-based theories use the principles of respect for patient autonomy, beneficence/nonmaleficence, and justice to guide conflict resolution. (2) Other helpful approaches to obstetric conflict, in particular, include feminist theory and the ethics of care. (1)(3) Because of the emotionally laden issues involved in protecting both the rights of women and the best interests of the fetus, conflicts often are approached best by using a comprehensive analysis that incorporates a variety of perspectives. Pediatricians and pediatric subspecialists who care for the child after delivery can play an important role in helping provide perspective about potential fetal outcomes.

Feminist theory evaluates ethical issues from a gender-based perspective. In particular, feminist ethics point to distinctions in how women are treated in comparison with men, rather than use a neutral perspective in decision-making. (1)(3) For example, some hospital policies and state laws exclude pregnant women from participating in health care decisions, such as advanced directives refusing treatment. (4) This viewpoint implies a lack of competency of pregnant women to participate in health care decisions and contributes to a distorted view of women as decision makers. Feminist ethics calls attention to such inequities and exclusions and asks whether a moral wrong is perpetrated by such gender-biased policies. Feminist theory can be considered in relation to this question: “If the patient were not pregnant and was refusing treatment, would her wishes be respected?” Another example would be to ask, “Is there a comparable situation in which one would consider forcing a father to undergo treatment to benefit his child?”

The ethics of care evaluates the moral dimension of relationships with others. (1) Many pregnant women

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have other children and family obligations that inform their decision-making. Care-based ethics asks, “What is the patient’s relationship to the fetus? To her physicians? To her social unit?”

The use of feminist theory and the ethics of care can reframe issues of obstetric conflict in terms of the patient’s values and life experiences to understand and support her decision or devise additional treatment strategies.

Refusal of Intervention: Declining Cesarean Delivery for Fetal Distress
Consider a pregnant woman who presents in labor at term, bearing a large fetus at risk for dystocia. She is told that a cesarean delivery is the best route of delivery for the fetus’ well being. She declines the operation and requests a natural childbirth. The fetus begins to have heart rate abnormalities, suggesting a nonreassuring status. The pregnant woman continues to decline the recommended cesarean delivery.

Who Is the Patient Here: the Pregnant Woman, the Fetus, or Both?
Over the past decade, the increasing use of technology to visualize and test the fetus during pregnancy has led us to consider the fetus as a patient separate from the pregnant woman. (4) (5) This philosophy contrasts with earlier views of pregnancy not being a medical condition but an extension of nature, thus leading to the view of the fetus as having separate interests to be addressed by the medical team. Language around obstetrical decision-making reinforces the separate consideration of the fetus from the pregnant woman (such as “fetal distress” or “fetal interests”). Nonetheless, access to the fetus for treatment must occur through the pregnant woman’s body.

Consider other situations in which medical intervention to benefit one patient (eg, a child with end-stage renal failure needing a transplant) involves risk to another patient (eg, the organ donor) when the two patients are not “intertwined.” Would you consider both individuals to be your “patient” if you were the transplant surgeon? As a pediatrician, would you expect a parent to donate a kidney to a child under such circumstances? Respect for autonomy, feminist ethics, and the ethics of care guides us to acknowledge the competent pregnant woman as the decision maker for issues related to her pregnancy, “bodily integrity,” and fetal well being. (1)

What Are the Best Interests of the Fetus and the Pregnant Woman?
There are aspects of this situation in which the interests of the mother and the fetus are aligned. In general, a pregnant woman is highly motivated to ensure the health of her fetus, and she desires a good pregnancy outcome for herself and her future child. (3)(4) Maternal psychological well being is important for both fetal and neonatal well being. Optimal maternal health ensures fetal health. Defining areas in which maternal interests and fetal interests are aligned is important for maintaining a therapeutically aligned relationship with the pregnant woman. If the patient has a strong aversion to operative delivery, it may be for good reason. It can be helpful to explore those reasons to understand and honor the patient’s perspective.

What Facts Inform the Decision-Making Process?
A foundational statement in medical ethics is that “good ethics begins with good facts.” In many situations of obstetric conflict, the body of evidence supporting the recommended intervention may not be comprehensive or as conclusive as initially presented. (4) The medical evidence supporting any recommendation for route of delivery often is incomplete. In cases in which courts have intervened to order cesarean delivery, for example, the fetus often has been delivered unharmed by the vaginal route. (4)(5)(6) Cesarean deliveries have increased in the United States without comparable improvements in neonatal outcome.

This situation illustrates that, in every case, the evidence for potential harm to the fetus must be carefully and objectively analyzed. When evidence supporting the treatment recommendation is weak, uncertain, or not available, and outcomes vary, there is poor ability to predict individual outcomes. In obstetric conflict about route of delivery, this uncertainty is often the case, and emphasis on the conflict may be disproportionate to what the evidence indicates. Again, respect for patient autonomy guides us to honor her decision to accept or refuse treatment recommendations in virtually all circumstances. (5)

In addition, the American College of Obstetrics and Gynecology Committee Opinion on Maternal Decision Making, Ethics, and the Law, recommends, “Pregnant women should not be punished for adverse perinatal outcomes,” and “Pregnant women’s autonomous decisions should be respected.” (5) We should presume these decisions are based on the best medical evidence and facts available to guide her decisions at the time.

Thus, when the evidence for treatment benefit is unclear, providers should minimize the polarization and conflict around a refusal of treatment. Although the pregnant woman can decline cesarean delivery, continued
conversation with her as labor progresses may lead to changes in her decision. Preserving the physician-patient relationship in a compassionate, professional manner will allow ongoing reevaluation of the decision, depending on whether the fetal status improves or worsens and whether the mother is able to deliver vaginally or not.

How Does the Gestational Age of the Fetus Affect Decision-Making?
Fetal interests and medical analysis of the benefits and harms of delivery will vary with gestational age. However, there may be less data and even more uncertainty regarding outcome at extremely early gestations, and this reality should be acknowledged.

Should You Go to Court to Force a Cesarean Delivery?
Legal intervention to resolve obstetric conflict generally should be avoided. (4)(5)(6) Although individual judges in emergency circumstances have ordered cesarean delivery, such decisions have largely been overturned, on review, found to be lacking in due process for the pregnant woman, and exaggerating the medical benefit of intervention. Other consequences of forced intervention or coercion should be taken into account, in particular, regarding the trust relationship necessary between physician and patient. Pregnant women should not be threatened or legally coerced to accept treatment recommendations. (5) Specifically, there is consensus in the bioethics community that pregnant women with decisional capacity have the right to make an informed refusal of cesarean delivery. (4)(5) According to the American College of Obstetrics and Gynecology Committee Opinion on Maternal Decision Making, Ethics, and the Law, “In the absence of extraordinary circumstances, circumstances that in fact, the Committee on Ethics cannot currently imagine, judicial authority should not be used to implement treatment regimens aimed at protecting the fetus, for such actions violate the pregnant woman’s autonomy”. (5)

Other Considerations in Obstetric Conflict
There are countless other circumstances in which conflicts may arise between maternal and fetal well being during pregnancy. For example, a variety of malignancies can occur in pregnant women and result in significant morbidity and mortality to the woman or her fetus. (7) Decisions around treatment must be individualized based on the best available medical information regarding prognosis, the stage in pregnancy, and the pregnant woman’s life circumstances and values. Although the context of their decisions will vary, pregnant women should have the same rights to refuse treatment as nonpregnant women. (4)(5)(6)

It is interesting to note how societal values and perspectives may be more sympathetic to a woman’s decision to refuse cancer treatment to benefit the fetus, even if such a decision could harm her survival or health. Such decisions are viewed as “altruistic,” whereas decisions to pursue treatment that may preserve her life but result in pregnancy loss may be viewed as “selfish.” Physicians and other members of the health care team should avoid assigning value judgments that reflect those of the providers rather than the patients.

For particularly difficult cases, informal or formal ethics consultation may be helpful to address the ethical issues involved. Incorporating a variety of perspectives, including those of pediatric and obstetrical care providers, and other stakeholders, as well, may help develop treatment options and support an ethical decision-making process.

Conclusions
Ultimately, moral theory compels physicians to accept a pregnant woman’s informed consent or refusal of treatment, according respect to her autonomy and bodily integrity, and her values regarding pregnancy outcome as well. In cases where her decision may harm her fetus, coercion to force treatment is never justified. In extraordinary cases, legal intervention has been attempted. Use of the courts to enforce treatment compliance by pregnant women has frequently been unsuccessful, or has activated processes that are hasty and incomplete, and such court rulings frequently are overturned on appeal. (4)(5)(6)

Evidence shows that continuing a trusting, compassionate, professional relationship with the pregnant woman generally results in greater success in improving maternal and child health. Feminist ethics perspectives can help detect subtle, gender-based biases in the clinicians’ approaches to conflict resolution and support collaborative decision-making by the pregnant woman and her health care team. Pediatricians can provide valuable perspectives about potential fetal outcomes, and should be involved in counseling the pregnant woman. The goal is to provide an ethical framework to optimize health outcomes for both the pregnant woman and her fetus.
Summary

- The interests of the fetus generally are aligned with those of the pregnant woman. When they are not, the fetal best interests should be discussed, but respect for the autonomy of the pregnant woman and her bodily integrity should prevail.
- Gender bias and discrimination toward women should be avoided, and the circumstance of pregnancy should not be used as a reason to infringe upon or limit a competent woman’s rights. Evidence indicates that providing prenatal care and treatment in a supportive, rather than coercive way is the most effective way to promote both maternal and child health.
- Concerns about potential harm to the fetus related to maternal decisions must be evaluated in the context of the best medical evidence, including what is known and what is uncertain. Threats or legal coercion should not be used to force treatment, in particular, to impose cesarean delivery.
- Hospital guidelines can be developed to support a framework of shared decision-making in the situation of maternal-fetal conflict and provide guidance for compassionate conflict resolution.
- Pediatricians have an important role in informing the discussion about care and outcomes.
- At times, an ethics consult may be helpful to mediate conflict resolution.
- Intervention by the courts is rarely appropriate or indicated and should be avoided.

References

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11. A mother whose pregnancy is 2 weeks short of term comes in for a routine obstetric visit. Variable decelerations are noted in the fetal heart beat. A cesarean delivery is recommended but the mother refuses. You are called in consultation because you are the pediatrician for the mother’s two other children...
and you have already been asked to provide care for this newborn. The most appropriate advice you provide to
the mother is to inform her that:

A. A cesarean delivery is the best approach.
B. It would be best to do a cesarean delivery, but you will support her regardless and recognize the
complexity of the decision.
C. Not undergoing a cesarean delivery would be child neglect.
D. This is purely an obstetrical decision that she should make in consultation with her obstetrician.
E. You recommend calling an ethics consultation.

12. A mother is found at 3 months of pregnancy to have acute lymphoblastic leukemia. You care for her first child
and are called in for consultation. The mother is considering refusing chemotherapy and continuing her
pregnancy. Because you are the family pediatrician, you are asked to meet with her. The most appropriate
advice would be to:

A. Inform her that her responsibilities to her other child and her family should be the primary focus of this
decision.
B. Inform her that she must begin chemotherapy and should strongly consider terminating the pregnancy.
C. Note that some states exclude pregnant woman from participating in health care decisions and that she
should follow the advice of her obstetrician and oncologist.
D. Note that depression is common in pregnancy and she should rely on others to make this decision.
E. Respect her decision just as you would respect the decision to defer therapy in an individual who was not
pregnant.

13. In understanding the management of potential conflicts between the mother and the fetus, which of the
following best applies?

A. Court action is infrequent but is usually upheld on appeal.
B. Gender bias plays much less of a role today.
C. Legal intervention is an important tool to protect the fetus.
D. The autonomy and bodily integrity of the mother is critical.
E. The primary medical role is played by the obstetrician.

14. Ethical frameworks are important in managing potential conflicts between what is in the best interests of the
mother as opposed to the fetus. Which of the following most accurately reflects one theoretical approach to
managing these conflicts?

A. If the mother was not pregnant, would her own health care decisions be respected?
B. Pregnant women are now always allowed to participate in health care decisions.
C. Pregnant women should consider their obligations to their other children first.
D. The father’s wishes should be considered when such conflicts arise.
E. The high risk of depression during pregnancy justifies overruling maternal decisions.

15. A pregnant woman whose children you care for is experiencing a severe flareup of a chronic medical disorder,
the treatment of which could be harmful to the fetus. She seeks your advice as to whether she should agree to
the treatment. The most appropriate response you can give is:

A. If she undergoes the therapy, any adverse consequences experienced by the baby will be seen as her fault.
B. The hospital Committee on Ethics has been suggested, but has nothing to offer.
C. This is a complex matter for the courts to decide.
D. This is a philosophical decision and a detailed analysis of the medical facts is not necessary.
E. You are planning to discuss all aspects of the situation with her and will respect her decision.
The reader is encouraged to write possible diagnoses for each case before turning to the discussion.

The editors and staff of Pediatrics in Review find themselves in the fortunate position of having too many submissions for the Index of Suspicion column. Our publication slots for Index of Suspicion are filled through 2013. Because we do not think it is fair to delay publication longer than that, we have decided not to accept new cases for the present. We will make an announcement in Pediatrics in Review when we resume accepting new cases. We apologize for having to take this step, but we wish to be fair to all authors. We are grateful for your interest in the journal.

Case 1: Persistent Fever and Cough Following Episodes of Emesis in a 7-year-old Girl

Case 2: Blurry Vision and Unilateral Dilated Pupil in a 14-year-old Girl

Case 3: Swelling, Pain, and Erythema of the Thumb in a 10-year-old Girl With Habits of Nail Biting and Thumb Sucking

Case 1 Presentation

A 7-year-old girl presents to the emergency department with persistent fever and cough for 9 days. She was in her usual state of good health until she vomited twice 11 days earlier. She subsequently developed cough and fever, prompting three visits to an urgent care center in the preceding 9 days. She denies shortness of breath, chest pain, diarrhea, rash, urinary symptoms, or sore throat. A chest radiograph on the fourth day of fever was normal.

Physical examination reveals a temperature of 102.9°F, heart rate of 115 beats per minute, respiratory rate of 28 breaths per minute, blood pressure of 110/65 mm Hg, and pulse oximetry reading of 98% in room air. Generally, she appears well, with occasional coughing during the visit. On respiratory examination, there is good air movement bilaterally, and no rales or wheezes are heard. The rest of the physical findings are normal.

Her white blood cell count (WBC) is $25\times10^3/\mu L$ with 88% neutrophils, 8% lymphocytes, and 4% monocytes; her C-reactive protein level is 16 mg/dL (normal <0.5); and an erythrocyte sedimentation rate (ESR) is 70 mm/hour. Results of her complete metabolic panel and urinalysis are normal. A blood culture and urine culture come back negative. An additional imaging study reveals the cause of her prolonged illness.

Case 2 Presentation

A previously healthy 14-year-old girl presents with blurred vision in the right eye of a few hours’ duration. The blurring is worse while looking at close rather than at far objects. There is no history of trauma, ingestion of toxic substances, or recent illness, including headache, nausea, vomiting, weakness or tingling of the extremities, eye pain, ptosis, diplopia, or other symptoms referable to the cranial nerves. The past, social, and family histories are noncontributory, other than the presence of asthma and dry eyes in the mother.

On physical examination, the girl appears healthy and in no apparent distress. Vital signs are normal for age. Ocular examination reveals the visual acuity at distance to be 20/20 in both eyes. Near vision is significantly impaired in the right eye and normal in the left eye. The intraocular pressure is normal to palpation. Extraocular movements are intact, with normal slow and fast movements. The right pupil measures 7 mm in diameter in dark and light. There is no direct or consensual light response in that eye.
eye, and the pupil does not react in accommodation. There is no afferent pupillary defect. The left pupil measures 5 mm in the dark and reacts normally to light and in accommodation. There is no ptosis, the conjunctivae and sclerae are white, and the cornea is clear with a deep anterior chamber. There is no disc edema on funduscopic examination and the retina is intact and flat. Findings on neurologic examination are normal. Additional history and examination lead to the diagnosis.

Case 3  Presentation
A 10-year-old girl presents to the emergency department with a 7-day history of swelling and pain of her right thumb. The girl has had a habit of nail biting and sucking her right thumb since she was 5 years old. She denies fever, cough, runny nose, trauma, coexisting infection, or a recent manicure.

On physical examination, she is afebrile and has erythema, swelling, and tenderness of the right thumb since she was 5 years old. She denies fever, cough, runny nose, trauma, coexisting infection, or a recent manicure.

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The differential diagnosis for prolonged fever includes infection, connective tissue diseases, oncologic processes, and Kawasaki disease. This patient’s continued cough directed her clinicians to the respiratory system. The vomiting that occurred 2 days before the fever may have been associated with an acute aspiration event, ultimately progressing to abscess formation. The patient was started on ceftriaxone and clindamycin. An immunodeficiency workup was negative. She was discharged 3 days after admission on oral amoxicillin and clindamycin, for a total of 6 weeks of antibiotics. A follow-up chest computed tomography (CT) scan at 5 weeks showed resolution of the abscess with residualatelectasis. Six months later, she continues to be well.

The Condition
Lung abscesses in otherwise healthy children are uncommon because they usually occur in patients who have a predisposition to aspiration or who are immunodeficient. In the developing world, lung abscesses are more prevalent when there is poor nutritional status, immunodeficiency, poorly controlled epilepsy, dental disease, and alcoholism. Children with neuromuscular disease, seizure disorder, pulmonary disease, and...
immunodeficiency are predisposed to develop necrosis of the pulmonary parenchyma and cavity formation that define a lung abscess. Patients with Lemiere syndrome and tricuspid valve endocarditis also are prone to lung abscesses.

**Diagnosis**

The diagnosis usually is made after a prolonged period of respiratory symptoms and fever. Chest radiography shows air-fluid levels in a cavity within lung tissue. CT scans can differentiate abscesses from pulmonary sequestration, cysts, and pleural collections, but are not absolutely necessary for diagnosis or management. The organisms involved include anaerobes, *Staphylococcus aureus*, *Streptococcus*, *Mycobacterium*, and fungi. Often, lung abscesses are polymicrobial. Infection with anaerobes typically occurs after an aspiration event. Typical anaerobes include *Peptostreptococcus*, *Prevotella*, and *Fusobacterium nucleatum*. Clinical features associated with an anaerobic abscess include purulent sputum in an older patient, gingival disease, and an inability to coordinate swallowing with protection of the airway.

Lung abscesses caused by *S. aureus* are associated classically with influenza infection and typically cause great morbidity and mortality, despite appropriate antibiotic therapy. Organisms such as *Klebsiella*, *Mycobacterium*, and fungi should be considered if the patient has an underlying immunodeficiency or known risk factors, such as chronic granulomatous disease. A purified protein derivative skin test should be strongly considered, especially if there are risk factors for tuberculosis.

**Treatment**

The treatment of an abscess, in general, is drainage of the collection. Lung abscesses are an exception to this rule, given their deep and precarious location. Often they can be managed with antibiotic therapy alone. Clindamycin covers anaerobes, organisms that produce β-lactamase, and *Staphylococcus*, making it the first-line therapy in treating uncomplicated lung abscesses. In immunodeficient patients, antibiotics should be directed at more unusual organisms. Rarely, lung abscesses need to be drained by a CT-guided transthoracic approach. Patients with primary lung abscess generally do well, with cure rates of 90% to 95% using antibiotics.

**Lessons for the Clinician**

- Lung abscesses are uncommon but may result from untreated community-acquired pneumonia, an aspiration event, or immunodeficiency.
- A history of vomiting, prolonged fever, and cough should lead one to consider aspiration pneumonia or lung abscess in the differential diagnosis.
- Most patients with lung abscesses present with indolent symptoms that evolve over a period of weeks to months and include fever, cough, and sputum production in older patients.

*(Eric Balighian, MD, Department of Pediatrics, Johns Hopkins Hospital St. Agnes Hospital, Baltimore, MD)*

**Confirmation of the Diagnosis**

This patient did not need any confirmatory tests because the diagnosis was evident by history. In some cases, however, especially in cases of malingering, this history is not readily available. In those situations, the diagnosis can be confirmed by using pilocarpine, a direct-acting parasympathomimetic drug. A 1% solution causes pupillary constriction in normal pupils and in patients with a dilated pupil secondary to third nerve palsy. Because dilation caused by ipratropium is directly blocking the cholinergic receptors, the pupil in this case would not respond to pilocarpine.

**Pupillary Response**

The key to diagnosing pupillary abnormalities is to differentiate afferent from efferent defects by using the swinging flashlight test and examining the pupils in light and dark (Fig 3).
1. Afferent: Because the pupillary response is consensual, shining the light into one eye causes the other pupil to constrict under normal circumstances. If the light source is swung back and forth between the two pupils, both pupils will stay constricted; however, if there is an abnormality in one optic nerve (ie, optic neuritis), shining the light in the eye with the normal optic nerve will cause both pupils to constrict. But if the light is immediately swung over to the eye with the abnormal optic nerve, both pupils will enlarge. This situation is known as an afferent pupillary defect, or Marcus Gunn pupil.

2. Efferent: The abnormal pupil will have an abnormal response regardless of which eye the light is shining into. In this case, the pupils will be of different sizes.

   a. If the difference is greater in the light, it indicates that the larger pupil is abnormal because it cannot constrict, as in a third nerve palsy owing to pathology in the parasympathetic pathways.

   b. If the difference in size is greater in the dark, it indicates that the smaller pupil is abnormal because the pupil cannot dilate, as in Horner syndrome, owing to pathology in the sympathetic pathways.

**Differential Diagnosis for Dilated Pupil**

1. Third nerve (oculomotor) palsy with pupil involvement: The third nerve emerges from the midbrain very close to the posterior communicating artery. Therefore, an aneurysm at the junction of the internal carotid artery and the posterior communicating is an important cause of third nerve palsy. The pupillary fibers travel from the Edinger-Westphal nucleus with the third nerve to the orbit, where they synapse in the ciliary ganglion. These fibers are located peripherally in the nerve and therefore receive dual blood supply from the vasa nervosum as well as the pial vessels. Therefore, the fibers are relatively spared in ischemic oculomotor palsy.

   Compressive lesions such as masses and aneurysms, however, compress the pupillary fibers early and result in a dilated pupil from lack of parasympathetic innervation. Therefore, a pupillary finding consistent with third nerve palsy is an indication for urgent imaging, especially if the patient is complaining of headache.

   The symptoms of third nerve palsy are ptosis and diplopia. If the ptosis is complete, the patient may not complain of diplopia because the visual axis is covered. Besides demonstrating ptosis, the eye will be turned down and out because all the extraocular muscles are supplied by the third nerve except the lateral rectus, which moves the eye out, and the superior oblique, which moves it down. Partial third nerve palsy also may manifest pupillary involvement if there is compression of only some of the nerve fibers from a small lesion.

2. Tonic pupil: A syndrome of tonic pupil associated with tendon areflexia is caused by loss of ganglion cells in the ciliary ganglion. The pupil is dilated and shows vermiliform movements in response to light. Because there is postganglionic damage, this disorder is associated with denervation hypersensitivity, and the pupils will constrict in response to dilute pilocarpine (0.1%) (Fig 4).
3. Eye trauma: Severe blunt trauma can result in small tears of the pupillary sphincter. Close slit lamp examination demonstrates the tiny tears at the pupillary margin.

4. Angle closure glaucoma: An acute increase in intraocular pressure results in a cloudy cornea, a shallow anterior chamber of the eye, and a fixed pupil. This type of glaucoma can occur in children after ocular trauma or as part of Sturge-Weber syndrome.

5. Other transient causes of dilated pupil include migraine and seizures and may be unilateral.

6. One must consider other drugs, specifically transdermal scopolamine. Patients apply the patch, do not wash their hands, touch the eye, and cause the pupil to be abnormal for a day or more.

7. Healthy individuals can have a certain degree of physiologic anisocoria, usually less than 0.5 mm. In this situation, however, the normal pupillary responses to light and in accommodation are preserved.

Lessons for the Clinician
- Unilateral dilated pupil in the absence of other neurologic signs should raise the suspicion of a pharmacologic cause; careful history is necessary to identify the causative substance.
- Distinguishing afferent from efferent causes and sympathetic from parasympathetic causes is essential in determining the pathologic process resulting in an abnormal pupil.
- Pharmacologic testing can be a useful adjunct, but only in cases in which the history and examination are not adequate for diagnosis.

(Sanjeev Y. Tuli, MD, Sonal S. Tuli, MD, University of Florida, Gainesville, FL)

Case 3 Discussion
The radiograph of the right hand suggested a subtle fracture of the distal first phalanx. MRI revealed hypointensity on T1-weighted images and hyperintensity on T2-weighted images within the first distal phalanx, compatible with bone marrow edema and suggestive of osteomyelitis (Fig 5). Deep culture of the wound grew methicillin-sensitive S. aureus. Antibiotics were changed to IV cefazolin and rifampin, the patient improved, and she was discharged with no other complications and given an oral antibiotic. Seven days after discharge, the right thumb swelling and tenderness had resolved, and there was full range of motion.

The Condition
Nail biting can cause sores on the cuticles. It also may cause bleeding and increase the risk of infections around the nail beds (paronychia) or tip of the finger (felon or whitlow), or in the mouth. Serious deep tissue infections also may result from nail biting, although only a few cases of osteomyelitis have been reported as a complication of this habit. Osteomyelitis in this case was caused by spread of infection from a contiguous focus. This type of spread is seen more often after injuries, such as bites, puncture wounds, open fractures, and surgical procedures. A somewhat similar condition is seen after a stubbed toe injury.

The organisms that can cause osteomyelitis are dependent on the underlying condition; however, S. aureus is the most common organism at all ages. Other organisms are important pathogens in certain clinical situations, such as Pseudomonas...
aeruginosa in puncture wounds of the foot, Salmonella in patients with sickle cell disease, and Eikenella corrodens in bite injuries.

Diagnostic Evaluation
A history of nail biting in a child who presents with an abscess of the finger may suggest a diagnosis of osteomyelitis. Microbiologic and histopathologic evaluation in addition to detailed history and physical examination will help establish the diagnosis. A blood culture should be performed in all cases of suspected osteomyelitis. There are no specific laboratory tests that establish the diagnosis of osteomyelitis, but an elevated WBC count with left shift and elevated ESR or C-reactive protein may be observed.

Imaging studies play an important role in the diagnosis. Plain radiograph is performed initially to exclude other lesions, such as fractures or foreign bodies. MRI is the imaging study of choice for establishing the diagnosis of osteomyelitis. The presence of a fracture sometimes makes the diagnosis of osteomyelitis more difficult, especially in a small bone.

Management
The initial antibiotic therapy is based on the suspected bacterial pathogens, the results of Gram stain of aspirated materials, and other considerations (presence of resistant bacteria in the community). In children beyond the neonatal age, nafcillin, oxacillin, clindamycin, and cefazolin are drugs of choice when methicillin-resistant S. aureus is not a consideration. In clinical situations such as this one, in which mouth flora is a potential concern, amoxicillin/clavulanic acid or ampicillin/salbactam are appropriate choices. Specific agents or combinations and doses should be determined with local specialists in infectious diseases.

The duration of antibiotic therapy is individualized. For most cases of osteomyelitis, the treatment is 4 to 6 weeks. Change from IV to oral antibiotics can be made once the patient shows clinical improvement and the acute phase reactants are decreasing.

Several treatment measures are described to prevent or stop nail biting. Some focus on behavior modifications, and others use physical barriers to prevent nail biting. The most important aspect is to avoid punishment. Keeping nails trimmed and filed or using nail polish may prevent placing the fingers or thumbs in the mouth. Wearing gloves and applying adhesive bandages or colored stickers also may prevent nail biting.

Lessons for the Clinician
• Nail biting is common among young children and adolescents.
• Nail biting can cause infections of soft tissue, felon, whitlows, abscesses, oral infections, and, rarely, osteomyelitis.
• Nail biting needs to be treated when it interferes with normal activities or causes significant bleeding and infections.

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To view Suggested Reading lists, for these cases, visit http://pedsinreview.aappublications.org and click on “Index of Suspicion.”
In Brief

Pleural Effusion

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Pleural effusions are abnormal collections of fluid in the pleural space, which is a potential space between the parietal (chest cavity) pleura and the visceral (lung) pleura. Normally, the pleural space contains a small amount of fluid (lung) pleura into the pleural space. Restriction to mitral flow, as with mitral stenosis, does the same, but only rarely does right heart failure or pulmonary arterial hypertension cause excessive fluid to accumulate in the pleural space.

With hepatic cirrhosis, pleural effusions develop from leakage of transudative ascitic fluid into the pleural space across minor defects in the diaphragm, usually on the right side. Similarly, a pleural effusion can accumulate during peritoneal dialysis when dialysate leaks from the abdomen.

Nephrotic syndrome is marked by a reduction in oncotic pressure from hypoalbuminemia and by increased hydrostatic pressure from compensatory hypervolemia, both of which contribute to fluid moving into the pleural space. Rarely, hypercoagulability from nephrosis may result in pulmonary embolism that can cause an exudative pleural effusion.

In contrast to transudates, pleural exudates occur primarily as a result of pleural disease. The most common childhood effusions are parapneumonic, developing in conjunction with pneumonia or lung abscesses, but tuberculosis, autoimmune disease, and malignant infiltration also can cause exudative effusions.

In the neonatal period, chylothorax is the most frequent type of pleural effusion; other causes include hemoptysis, congenital nephrotic syndrome, hydrops fetalis, and complications from central venous catheter placement.

Chylothorax is the accumulation of chyle in the pleural space. Chyle, the lymph derived from the intestines and liver, transports chylomicrons containing long-chain triglycerides, plasma proteins, and lymphocytes via the thoracic duct to the central veins. The thoracic duct ascends on the right side of the vertebral column from the T12 vertebra, crossing to the left hemithorax at the T5 level. Thus, damage to the thoracic duct above T5 commonly causes a left-sided effusion; damage below this level causes a right-sided effusion. Bilateral effusions also can develop. Because chyle does not irritate the pleura, chylothorax usually is not associated with loculation or peel formation, and the high fatty acid content of chyle protects against infection.

Neonates can develop chylothorax from congenital lymphatic abnormalities that may be associated with Noonan, Turner, and Down syndromes, or from rupture of the thoracic duct with extension of the spine at birth. Acquired chylothorax in neonates and children most often follows cardiothoracic procedures. Other causes of chylothorax include rupture of the duct during violent coughing, obstruction of the superior vena cava, mediastinal inflammation, and malignant infiltration.

Diagnostic thoracocentesis is indicated for a significant pleural effusion without a known cause. If analysis reveals a transudate, additional therapy...
focuses mainly on managing the cause of the transudate. Exudates, however, usually require additional microbiologic, biochemical, and cytologic evaluation to identify the cause and allow planning of appropriate treatment. Therapeutic thoracocentesis may be indicated for relief of respiratory distress.

A turbid appearance results from a high cell count or high lipid content. Fluid that has a bloody appearance and a hematocrit level greater than half of the blood hematocrit probably represents hemothorax. Fluid from chylothorax usually is milky or turbid, but it may be serous, bloody, yellowish, or greenish.

Effusions can be classified as exudates if any one of three criteria is present:

- Pleural fluid-to-serum protein ratio is 0.5 or greater,
- Pleural fluid-to-serum lactate dehydrogenase (LDH) ratio is more than 0.6, or
- Pleural fluid LDH concentration is more than 66% of the upper limit of normal for serum.

Although these criteria are extremely sensitive for the identification of exudates (99.5%), they are not as specific. Approximately 20% of transudative effusions from congestive heart failure are identified as exudates, particularly when diuretic therapy increases the concentrations of protein and LDH in pleural fluid.

Pleural fluid usually is slightly alkalotic. The pH may be reduced in parapneumonic effusions, tuberculosis, malignancies, lupus, rheumatoid arthritis, and hemothorax. Glucose typically is reduced in exudates when the pH is reduced. A low pH with increased amylase is highly suggestive of esophageal rupture, especially when there is a history of trauma. If the concentration of triglyceride in the pleural fluid is >110 mg/dL, the likelihood of a chylothorax is >99%; with a triglyceride concentration <50 mg/dL, the chance of a chylous effusion is at most 5%.

Samples of pleural fluid should be anticoagulated to ensure accurate cell counts. Bacterial infections (occasionally tuberculosis) are associated with predominantly neutrophilic effusions. Lymphocytosis is seen with chylothorax, autoimmune diseases, tuberculosis, and malignancy. Malignant cells that may be seen on microscopy include nephroblastoma, Wilms' tumor, hepatoblastoma, malignant germ cell tumor, and rhabdomyosarcoma. Lung involvement with neuroblastoma is rare. Non-Hodgkin's lymphoma can present with a mediastinal mass, pleural effusion, and respiratory distress. Cytology of pleural fluid may help establish the diagnosis in critically ill children and allow initiation of appropriate chemotherapy.

The growth of bacteria, tubercle bacilli, or fungi from pleural fluid confirms infection. The isolation of aerobic and anaerobic organisms is improved by adding pleural fluid to blood culture containers at the bedside. In areas of high endemicity, pleural adenosine deaminase has a high positive predictive value for tuberculosis. The most common organisms isolated from parapneumonic effusions in children are *Streptococcus pneumoniae*, *Staphylococcus aureus*, and group A *Streptococcus*.

Although parapneumonic effusions may begin as sterile exudates, they can progress to an infected fibrinopurulent stage with adhesions and loculations that may then organize with formation of a pleural peel, preventing expansion of the underlying lung. When the infected effusion is thick, viscid, and purulent, it is termed an empyema, which raises the morbidity and mortality of pneumonia. Drainage of effusions becomes more difficult with development of loculation, and progression to loculation can occur when drainage is delayed by as little as 12 to 24 hours.

Parapneumonic effusions <10 to 20 mm in depth have a good prognosis and do not require drainage. Effusions >10 to 20 mm in depth should be sampled for analysis. Outcomes are poorer if the pH is <7.20, the glucose concentration is <60 mg/dL (3.3 mmol/L), the fluid is purulent, bacteria are cultured from the fluid, or the effusion occupies more than half of the hemithorax. These findings define a “complicated” parapneumonic effusion and indicate the need for drainage.

Imaging can identify parapneumonic effusions and associated conditions such as lung abscess. On plain chest radiography, the collection of a significant amount of pleural fluid causes blunting of the costophrenic angle on an upright posterior-anterior image, followed by the characteristic meniscus, eventually progressing to opacification of the hemithorax and displacement of the mediastinum. Freely flowing pleural effusions form dependent fluid layers that move when the patient assumes the lateral decubitus position, in contrast to pleural thickening that does not change with position.

Ultrasoundography is very sensitive for detecting small effusions, septations, and pleural thickening and can guide thoracocentesis. The procedure is portable and does not require sedation, but it is operator-dependent and is not effective in detecting abscesses beyond normal lung tissue or loculated effusions in the mediastinal area or in the fissures.

Computed tomographic (CT) scan is an excellent modality for imaging effusions, inaccessible loculations, atelectasis, and lung abscesses, and for guiding thoracocentesis, particularly because this imaging demarcates effusions from underlying pneumonia. The limitations of computed tomographic imaging include radiation exposure, expense, and the potential need for sedation.

The usual initial intervention for complicated pleural effusions is tube
thoracostomy with underwater drainage. Smaller tubes (8–12 French) probably are as effective as larger tubes and can be positioned under imaging guidance. Successful tube thoracostomy along with adequate antibiotic coverage should result in clinical and radiologic improvement within 24 hours. Instillation of fibrinolytic agents such as tissue thromboplastin activator into the pleural space may help resolve an empyema, but the exact role of fibrinolysis remains to be defined. When effusions persist after tube thoracostomy, especially with pleural loculations, thorascopic surgery can visualize the pleura, break down adhesions, and drain an empyema. Open thoracotomy and debridement may be necessary in the presence of thick pleural peel with trapped lung or with extensive debris. The role of thorascopic surgery as a primary treatment for complicated parapneumonic effusions has not been defined.

Prevention is preferable to treatment. Although the introduction of vaccine dramatically reduced the incidence of empyema from *Haemophilus influenzae* type B pneumonia, the 7-valent conjugated pneumococcal vaccine has been associated with an increased incidence of empyema in children despite decreases in pneumonia. It is hoped that the new 13-valent pneumococcal vaccine, which addresses serotypes associated with empyema, will reduce the incidence of empyema in children.

Comments: When Dr Muzumdar previously wrote about pleural fluid, I commented that, rightly, pediatricians are not quick on the draw with invasive procedures for children but sometimes our hesitancy can be counterproductive. Early drainage of a pleural effusion can be therapeutic in its own right, but particularly with rising rates of resistant pneumococcal and community-associated methicillin-resistant staphylococcal infections, thoracentesis can also provide material for culture to guide antibiotic use.

In his In Brief, Dr Muzumdar remarks that the role of fibrinolytic agents in the treatment of pleural disease remains to be defined. A study from the United Kingdom published in the *New England Journal of Medicine* (2011;365:518–526) provides evidence that, at least in adults, the combination of intrapleural tissue plasminogen activator and deoxyribonuclease improves fluid drainage, reduces the likelihood of surgery, and shortens the course of hospitalization, which neither agent on its own was able to do. One can hope that we will see confirmation in children.

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