Risks of antibiotics and antibiotic resistance explained

Why antibiotics matter in child care

Antibiotics are among the most important tools in pediatric medicine. They can prevent complications from bacterial pneumonia, pyelonephritis, meningitis, sepsis, some skin and soft-tissue infections, and selected cases of acute otitis media in children. When a child has a true bacterial infection, timely and appropriate antibiotic therapy can reduce morbidity, shorten illness, and in severe infections save life.

The challenge is that many childhood illnesses look similar early on. Fever, cough, sore throat, ear pain, abdominal pain, and rash may be caused by viruses, bacteria, inflammatory conditions, or noninfectious problems. Antibiotics have no activity against viruses, so giving them for a viral upper respiratory infection will not make the virus resolve faster. It can, however, expose the child to medication risks and increase selection pressure on bacteria living in the nose, throat, gut, and skin.

This is why clinicians often focus on probability and risk stratification: the child’s age, vaccination status, examination findings, duration of symptoms, local resistance patterns, immune status, and whether there are red flags such as respiratory distress, dehydration, altered mental status, or signs of

invasive infection. A careful "no antibiotic today" decision can be as active and protective as a prescription, provided there is clear follow-up guidance and safety-netting.

Immediate risks and side effects of antibiotics

Most children who need antibiotics tolerate them well, but adverse effects are common enough to take seriously. Gastrointestinal symptoms such as nausea, abdominal pain, loose stools, and diarrhea occur because antibiotics can disturb the normal gut microbiome as well as target the suspected pathogen. Some children develop antibiotic-associated diarrhea; rarely, more severe colitis can occur, especially after broad-spectrum exposure or repeated courses.

Allergic reactions are another concern. Mild rashes can occur for several reasons, including viral exanthems that coincide with treatment. True drug allergy may involve hives, swelling, wheeze, vomiting with systemic symptoms, or anaphylaxis. Because an inaccurate allergy label can limit future antibiotic choices, suspected reactions should be documented carefully and discussed with a healthcare professional; urgent symptoms require emergency care.

Other risks depend on the drug class, dose, duration, and the child’s medical history. Some antibiotics interact with other medicines, affect liver enzymes, alter kidney function, prolong the QT interval, or increase photosensitivity. In infants, premature babies, children with chronic kidney disease, immunocompromise, implanted devices, or complex neurologic conditions, the threshold for specialist input may be lower. The goal is not to fear antibiotics, but to respect them as biologically active treatments that should have a clear indication.

What antibiotic resistance really means

Antibiotic resistance means bacteria have acquired or selected traits that allow them to survive exposure to an antibiotic that would normally inhibit or kill them. Importantly, bacteria become resistant, not the child. A child may carry resistant bacteria transiently or persistently, and those bacteria can later cause infection or spread to others.

Resistance can arise through spontaneous mutation or by receiving resistance

genes from other bacteria. Mechanisms include producing enzymes that destroy the antibiotic, changing the antibiotic's binding target, pumping the drug out of the cell, or reducing drug entry. The more often bacteria are exposed to antibiotics, especially when exposure is unnecessary, incomplete, or too broad, the more opportunity resistant strains have to survive and multiply.

In clinical practice, resistance can turn a routine infection into a more complicated one. A resistant urinary tract infection may not respond to the usual first-line oral medicine. A resistant bloodstream infection may require intravenous therapy, hospitalization, broader-spectrum agents, or drugs with more toxicity. Families may experience delayed effective treatment, longer illness, additional testing, and higher costs.

At a population level, antimicrobial resistance is a major global threat. The World Health Organization reports that bacterial antimicrobial resistance directly caused an estimated 1.27 million deaths in 2019. Resistant organisms also place pressure on healthcare systems, and projections cited by WHO include very large future healthcare costs if resistance is not controlled.

Why overuse happens in children

Antibiotic overuse rarely happens because caregivers or clinicians are careless. It often happens because everyone is trying to protect a child under uncertainty. Parents may worry about a fever that persists through the night, missed school, a history of complications, or a sibling who became very unwell in the past. Clinicians may face limited appointment time, diagnostic uncertainty, and concern about missing an early bacterial infection.

Several common pediatric scenarios create pressure to prescribe. Ear pain may be viral, bacterial, or related to middle-ear effusion after infection; selected children can be managed with observation or watchful waiting for ear infection, while others need immediate antibiotics. Cough and nasal discharge may last one to three weeks after viral infections, and color change in mucus does not reliably prove bacterial disease. Sore throat requires clinical assessment and, when appropriate, testing for group A streptococcus rather than automatic treatment.

The COVID-19 pandemic highlighted another problem: antibiotics are sometimes

used during viral illness when bacterial coinfection is not established. Scientific literature has described antibiotic overuse as a major driver of resistance, and reports have raised concern that children receiving antibiotics in the context of COVID-19 had increased risks of poor outcomes in some settings. Such findings do not mean antibiotics caused every adverse outcome; they reinforce that antibiotics should be reserved for situations where bacterial infection is suspected or confirmed.

How resistance affects treatment choices

When resistance is present, clinicians may have fewer safe, narrow, convenient options. A child who could otherwise take an oral antibiotic at home might need intravenous therapy if the organism is resistant to first-line oral agents. Broader-spectrum antibiotics can be necessary, but they may further disrupt the microbiome and increase selection pressure for other resistant organisms.

Some bacteria are especially concerning because they combine virulence, healthcare spread, and multiple resistance mechanisms. The group often called ESKAPE pathogens includes organisms that can evade many available antibiotics and are associated with difficult-to-treat infections, particularly in hospital settings. In pediatrics, resistant infections may be seen in neonatal units, intensive care, children with central venous catheters, recurrent urinary tract infections, complex wounds, or frequent healthcare exposure.

Resistance also affects diagnostic strategy. Cultures, susceptibility testing, and source control become more important when initial treatment fails or when a child is at higher risk of resistant infection. This may mean urine culture before antibiotics for suspected febrile UTI, wound culture in selected purulent infections, blood cultures in severe illness, or reassessment if fever and symptoms do not improve as expected.

For families, the emotional burden is real. It is frightening to hear that an infection is "resistant." Still, resistance does not automatically mean untreatable. It means treatment must be more targeted, and the care team may need microbiology data, infectious diseases input, or hospital-level monitoring.

Using antibiotics wisely without undertreating children

Antibiotic stewardship is the practice of using antibiotics only when they are likely to help, and then choosing the narrowest effective agent, route, dose, and duration. In children, good stewardship must be balanced with developmental stage, immune vulnerability, severity of illness, and the practical realities of giving medicine safely at home.

Caregivers can support stewardship by asking focused questions rather than simply accepting or refusing a prescription. Helpful questions include: What bacterial infection are we treating? Is testing needed before starting? Are there signs that would make antibiotics urgent? What side effects should we watch for? When should improvement be expected? What should we do if the child vomits a dose or symptoms worsen?

If antibiotics are prescribed, follow the clinician’s instructions precisely. Do not save leftover medicine, share antibiotics between siblings, use old prescriptions for a new illness, or stop early without medical advice because the child looks better. Conversely, do not continue beyond the prescribed course unless instructed. The "right duration" varies by infection, organism, drug, and evolving evidence; shorter courses are appropriate for some infections but not all.

Prevention is also stewardship. Vaccination, hand hygiene, breastfeeding when possible, safe food handling, avoiding tobacco smoke exposure, and prompt care for concerning infections reduce the need for antibiotics. In children with asthma-related breathlessness in children or shortness of breath in children, distinguishing airway inflammation or viral wheeze from bacterial pneumonia helps avoid unnecessary antibiotics while ensuring respiratory danger signs are addressed.

When to seek prompt medical advice

Because children can deteriorate quickly, antibiotic caution should never become delayed care for a seriously ill child. Seek urgent medical assessment for signs such as difficulty breathing, blue or gray color, persistent lethargy, confusion, seizures, dehydration, severe pain, a non-blanching purple rash, stiff neck, persistent fever in a young infant, or a child who appears significantly worse than expected.

Reassessment is also important when a child is already taking antibiotics but is not improving. Depending on the infection, clinicians may expect fever, pain, or appetite to improve within a defined timeframe, often 24 to 72 hours, but this varies. Worsening symptoms, new rash, persistent vomiting, severe diarrhea, reduced urine output, or signs of allergy should be discussed promptly.

Families should feel comfortable saying, "I want to avoid unnecessary antibiotics, but I also want to know what would make this unsafe to watch." A good plan includes symptom care, expected illness course, follow-up timing, and clear red flags. This shared approach protects the individual child today and helps preserve antibiotics for children who will need them tomorrow.