

Helicobacter pylori gastritis

Microbial colonization · chronic active inflammation · divergent clinical outcomes

Pathogenesis, morphology and clinicopathologic interpretation

Dr Abu Suraih Sakhri

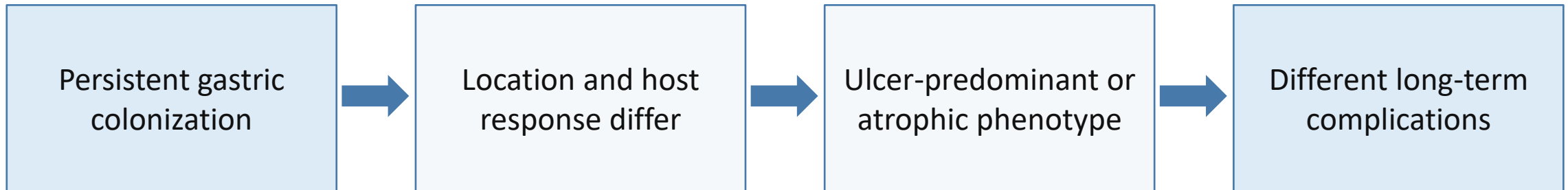
MBBS, MD (Pathology)

www.abusuraihsakhri.com

Learning objectives

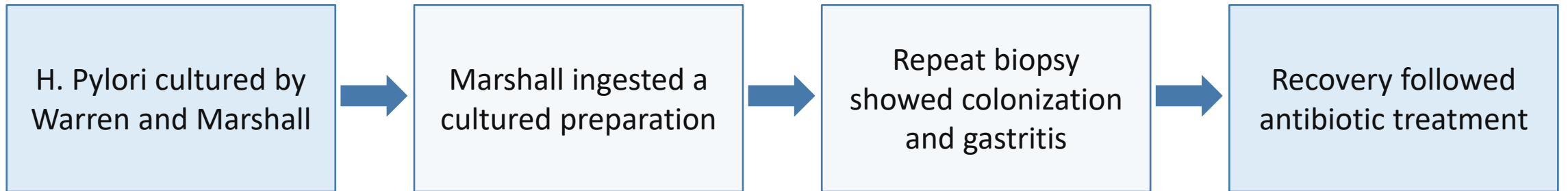
- Explain how H. Pylori survives and persists within gastric mucus.
- Relate antral versus extensive atrophic disease to acid output and complications.
- Recognize the characteristic pattern of chronic active gastritis.
- Select and interpret the major diagnostic modalities.

A single infection can produce divergent disease



The anatomic pattern of inflammation helps predict acid secretion, morphology and risk.

Evidence that the organism causes gastritis

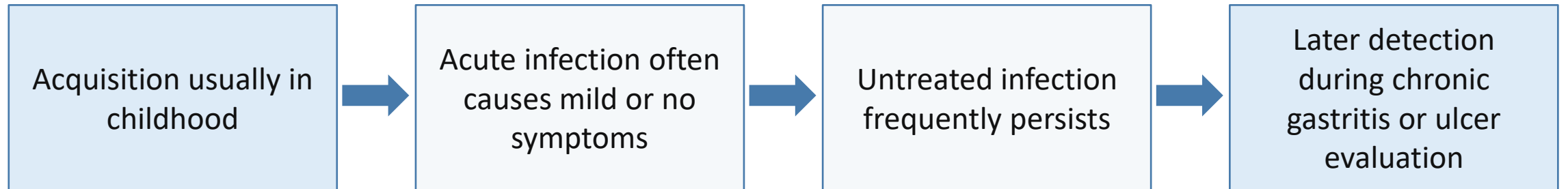


An experimental challenge linked bacterial infection to gastric inflammation.

The organism and its principal niche

- Curved or spiral-shaped bacillus adapted to gastric mucus.
- Resides predominantly in mucus overlying foveolar epithelial cells.
- Bacterial survival depends on movement, pH protection and adherence.
- Long-term colonization provokes chronic mucosal inflammation.

Natural history begins with colonization

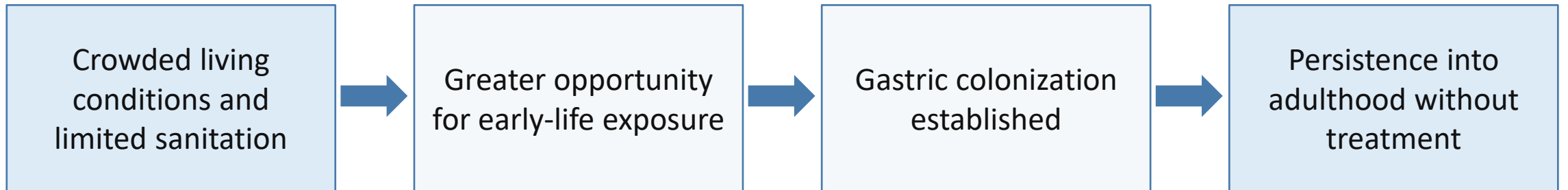


Infection can precede clinical presentation by many years.

The human reservoir and likely transmission

- Humans are the primary carriers.
- Fecal–oral transmission is considered the main route.
- Persistent asymptomatic colonization facilitates transmission.
- Acquisition is closely linked to the childhood environment.

Why childhood living conditions matter



Environmental exposure helps explain cohort differences in infection prevalence.

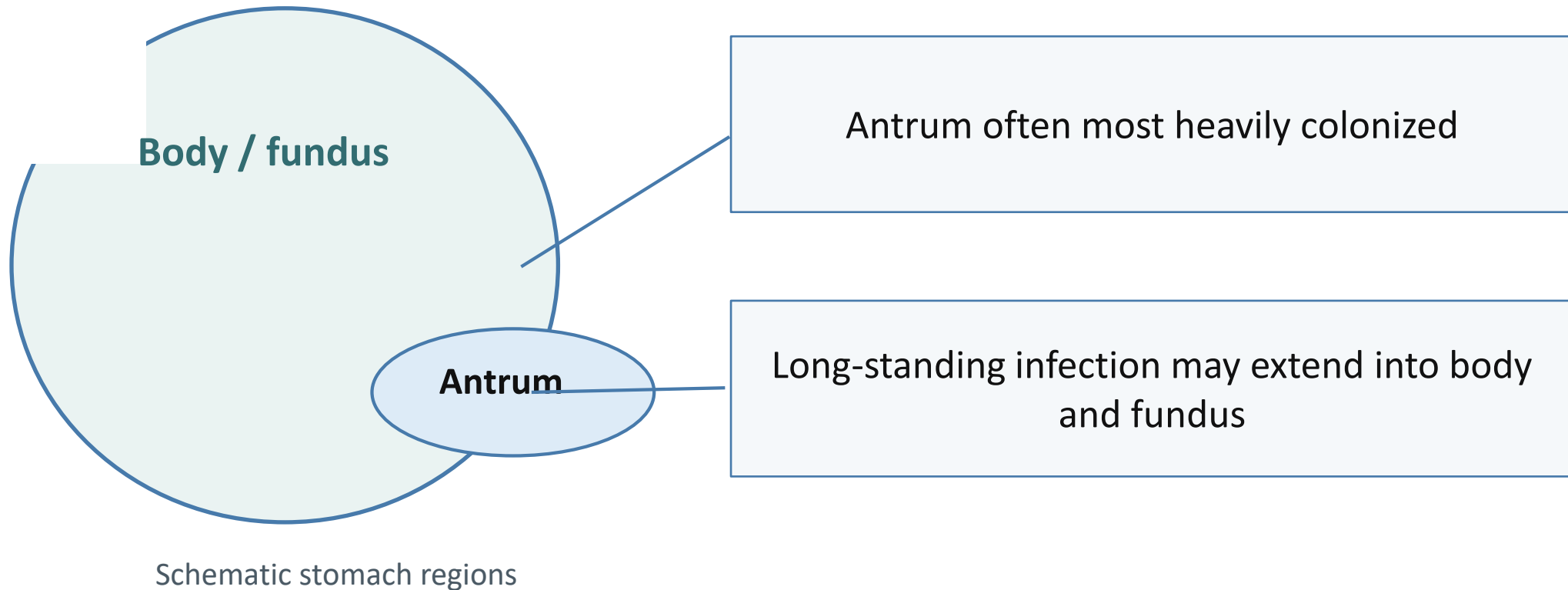
Risk associations reported in the United States

- Lower income and household crowding.
- Limited education and residence in rural settings.
- Birth outside the United States and older age.
- Differences between population groups may reflect social and historical exposures.

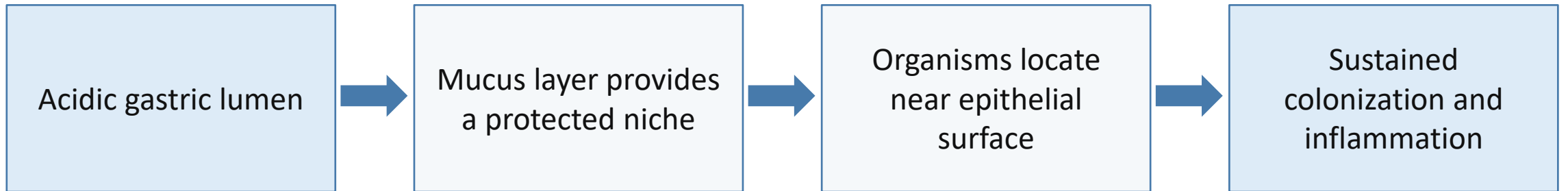
Age-associated prevalence of H. Pylori in the US

US age group	Reported infection estimate	Interpretation
Before 10 years	Uncommon in high-resource countries	Improved childhood sanitation
18–30 years	About 10%	Lower prevalence in younger cohort
Older than 65 years	Up to 50%	Higher historical exposure

Antral and corpus involvement are not equivalent



Survival requires overcoming gastric acidity

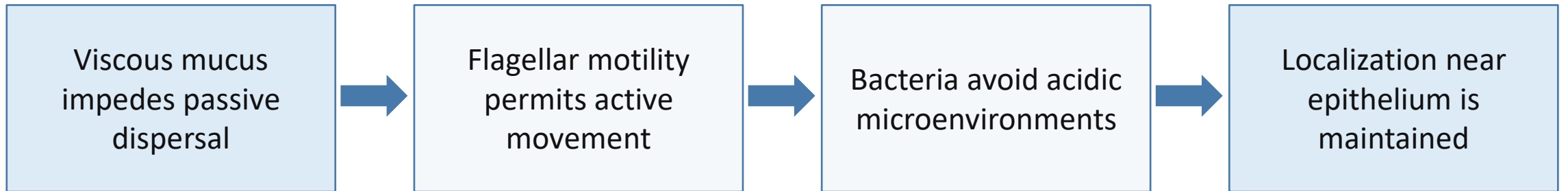


H. Pylori survives in a locally modified microenvironment rather than freely multiplying in highly acidic lumen.

Four bacterial virulence functions

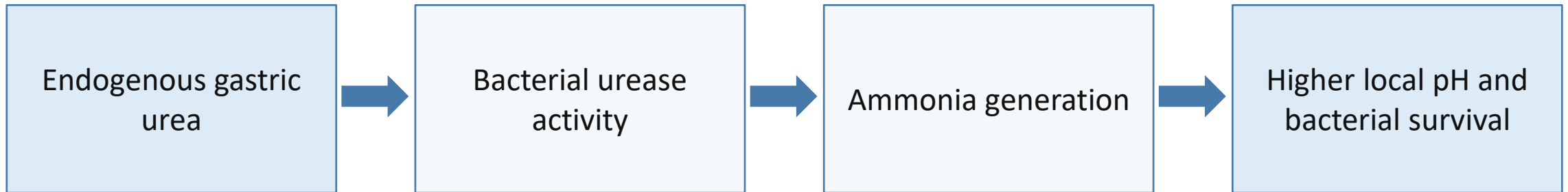
Virulence attribute	Principal contribution
Flagella	Movement through viscous gastric mucus
Urease	Generation of ammonia and elevation of local pH
Adhesins	Adherence to surface foveolar epithelial cells
CagA and other effectors	Alteration of epithelial functions and injury responses

Flagella support persistence in mucus



Motility is an adaptation to the structure and pH gradient of the gastric niche.

Urease creates a buffered microenvironment



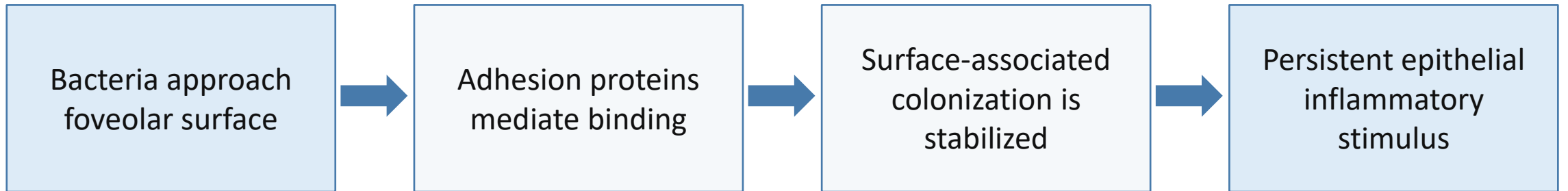
Urease protects the bacterium locally; It does not make the entire gastric lumen alkaline.

Why urease matters clinically

Urease is both a survival mechanism and a diagnostic target.

- Local buffering enables persistence in gastric mucus.
- Rapid urease testing uses gastric biopsy material.
- Urea breath testing exploits the same bacterial enzymatic activity.

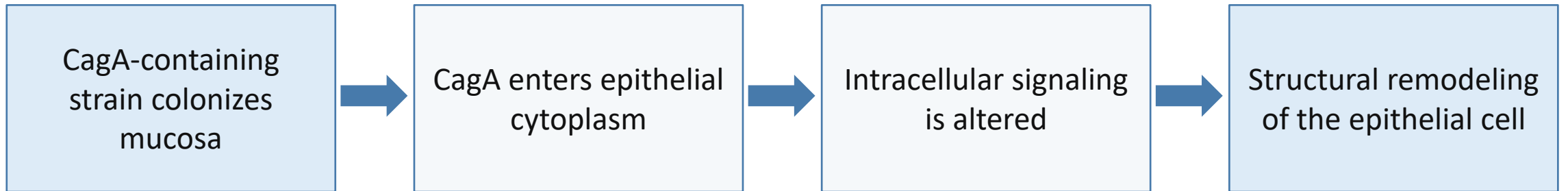
Adhesins retain bacteria at the epithelial surface



CagA and VacA: Epithelial virulence effectors

- CagA and vacuolating cytotoxin VacA.
- Experimental studies associate these factors with altered epithelial functions.
- Virulence-factor carriage varies among bacterial isolates.
- Observed clinical correlations do not establish a single deterministic outcome.

CagA modulates epithelial cell behavior



Robbins cautions that the contribution to human clinical outcomes remains substantially correlative.

Virulence does not equal inevitable cancer

Bacterial strain properties modify risk; They do not determine fate alone.

- CagA is associated with more extensive mucosal injury in some populations.
- Host cytokine responses and other defenses influence the phenotype.
- Population-level associations do not establish an individual prognosis.

CagA carriage differs across populations

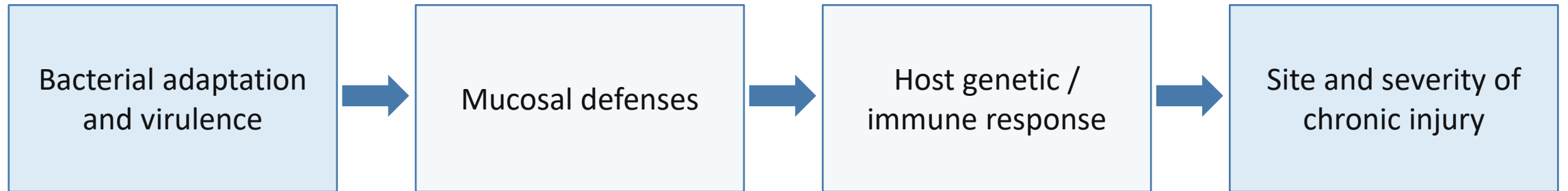
Population group	Reported proportion	Interpretation
All H. pylori isolates	CagA pathogenicity island ~50%	Virulence varies across strains
High gastric-cancer-prevalence populations	~90% of isolates	Association, not individual causation

Host cytokine balance shapes severity



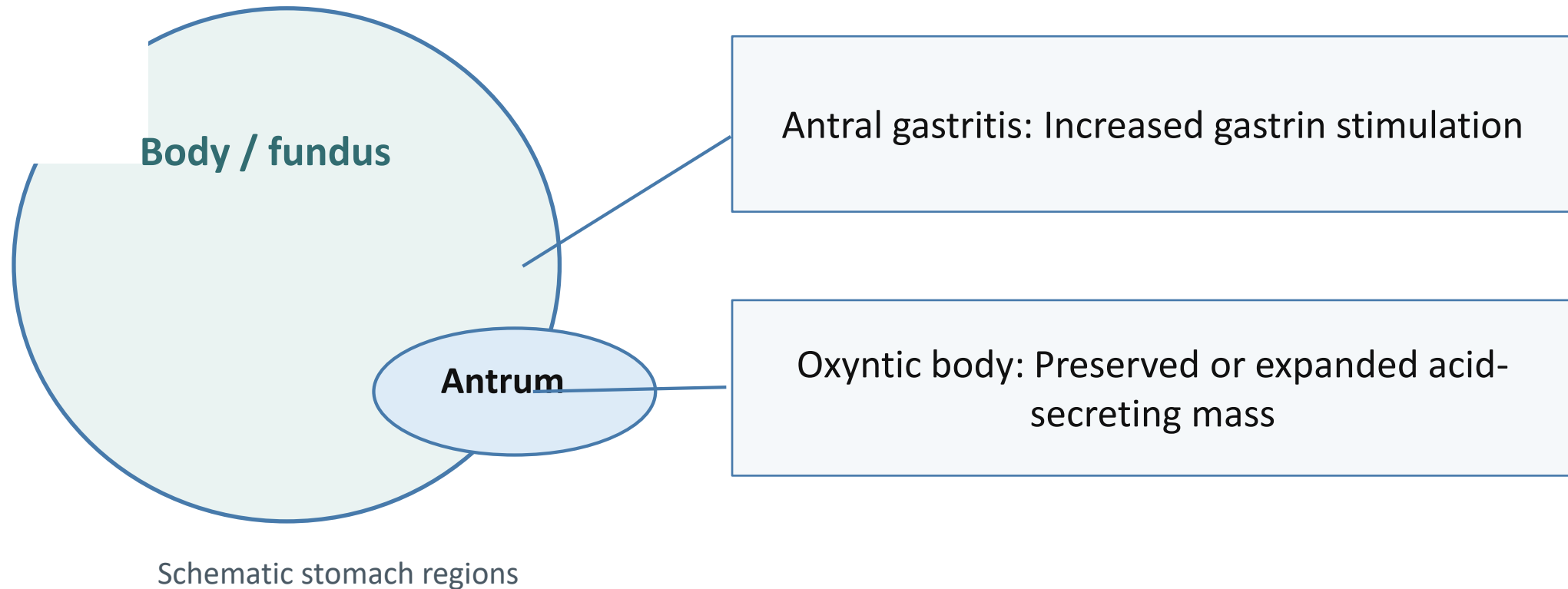
Possible genetic polymorphism associations; These are not diagnostic tests.

Disease severity emerges from three interacting domains

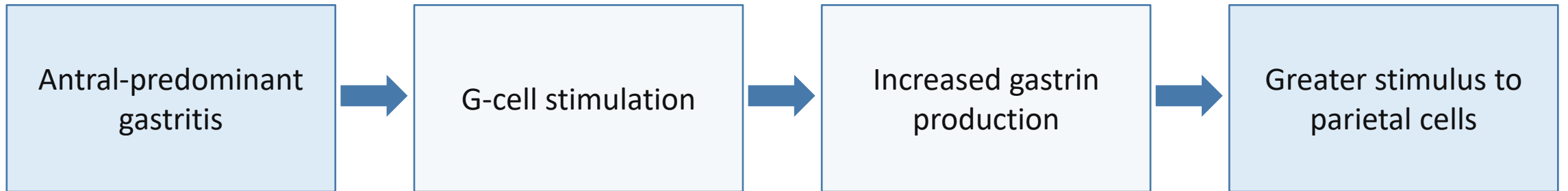


The same microbe can produce a spectrum of anatomic and clinical patterns.

Antral-predominant infection favors high acid output

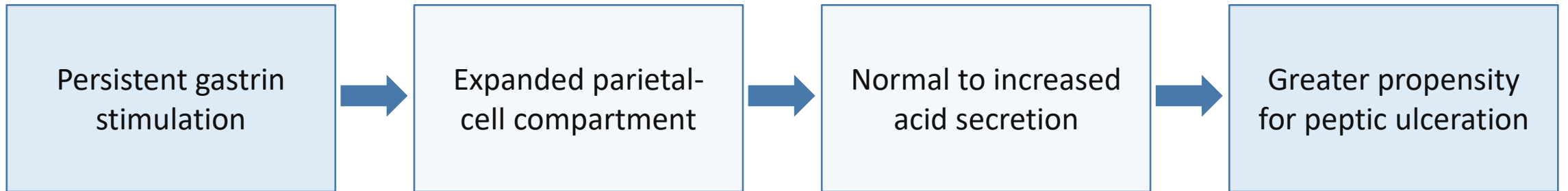


Antral inflammation changes G-cell signaling

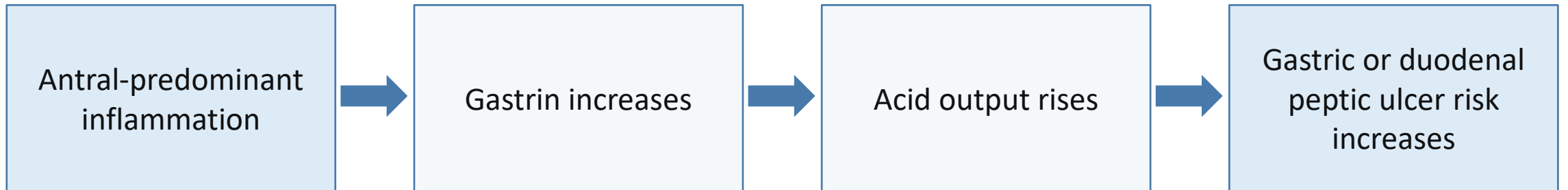


Inflammation in the antrum can alter acid physiology outside the antrum.

Parietal cell expansion links gastrin to acid

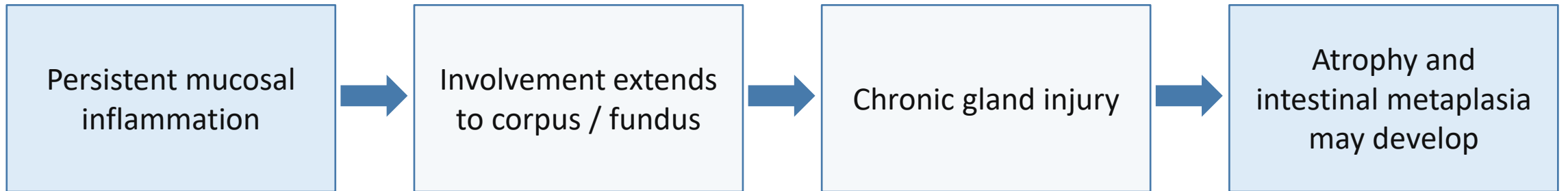


The ulcer-associated phenotype



Antral H. Pylori gastritis is a mechanism for ulcer risk, not itself an ulcer diagnosis.

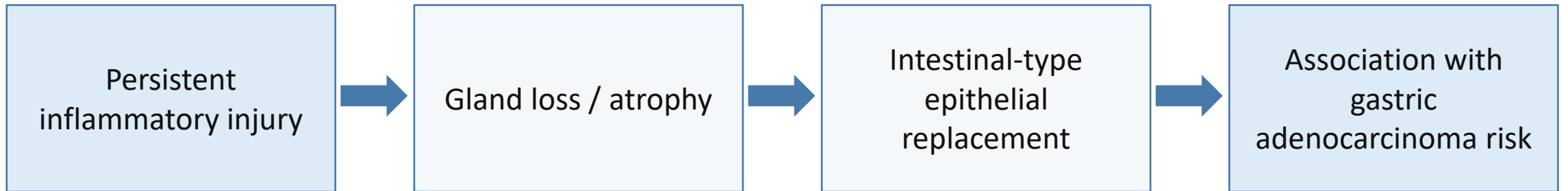
Long-standing infection can become extensive



H. Pylori-associated atrophy is typically patchy

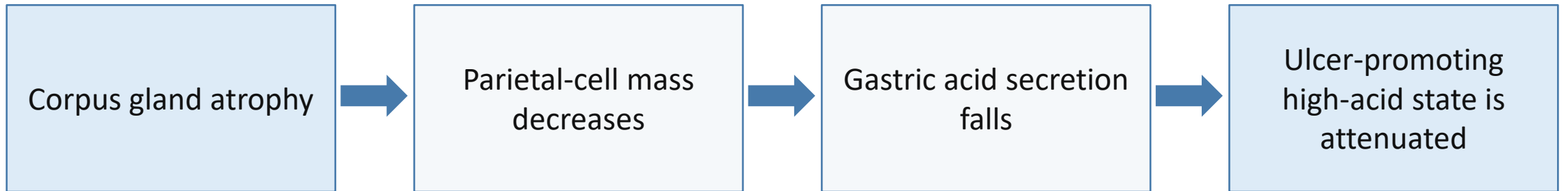
- Atrophy reflects loss of native gastric glands.
- Long-standing H. Pylori infection can damage corpus mucosa.
- Atrophy is often patchy rather than uniformly distributed.
- The process is not characterized by parietal-cell autoantibodies.

Intestinal metaplasia follows chronic mucosal injury



Metaplasia is a tissue adaptation and a marker of an altered carcinogenic milieu.

Loss of parietal-cell mass alters acid physiology



Gastrin rises despite reduced acid secretion

- Atrophic H. Pylori gastritis can impair acid production.
- Reduced acidity stimulates compensatory gastrin release.
- Residual parietal cells usually preserve some acid secretion.
- Hypergastrinemia is generally less marked than in autoimmune gastritis.

Two H. Pylori gastritis phenotypes

Antral-predominant

- Antrum is main inflammatory site
- Parietal-cell mass is preserved or increased
- Acid output normal or increased
- Peptic ulcer predisposition

Extended atrophic

- Body / fundus also involved
- Patchy parietal-cell loss
- Acid output reduced
- Intestinal metaplasia and cancer association

Why ulcer and carcinoma associations diverge

High-acid branch

- Predominantly antral H. Pylori gastritis
- Gastrin stimulation and increased acid output
- Greater duodenal ulcer propensity

Atrophic branch

- Inflammation extends to corpus / fundus
- Parietal-cell atrophy and lower acid output
- Metaplasia with adenocarcinoma association

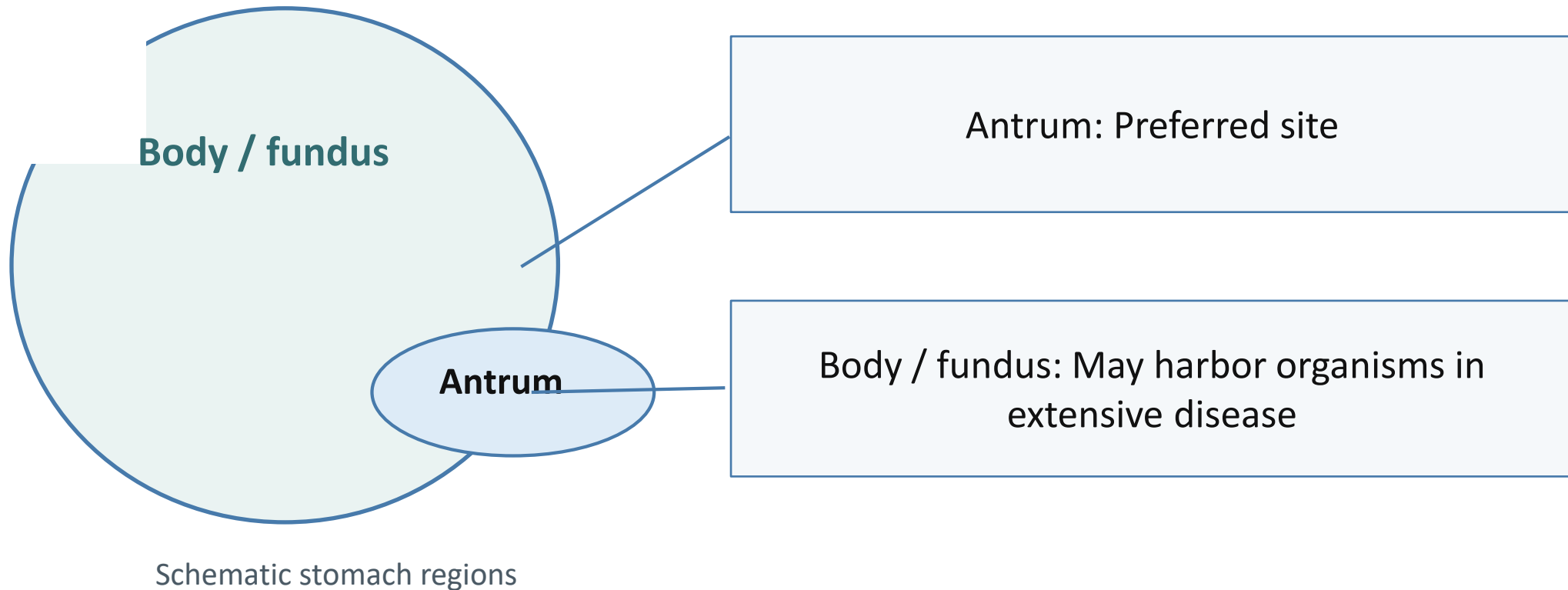
Typical endoscopic appearance of infected antrum

- Antral mucosa is commonly erythematous.
- Surface may appear coarse or nodular.
- Gross appearance is suggestive, not organism-specific.
- Histology or organism-targeted testing supplies etiologic evidence.

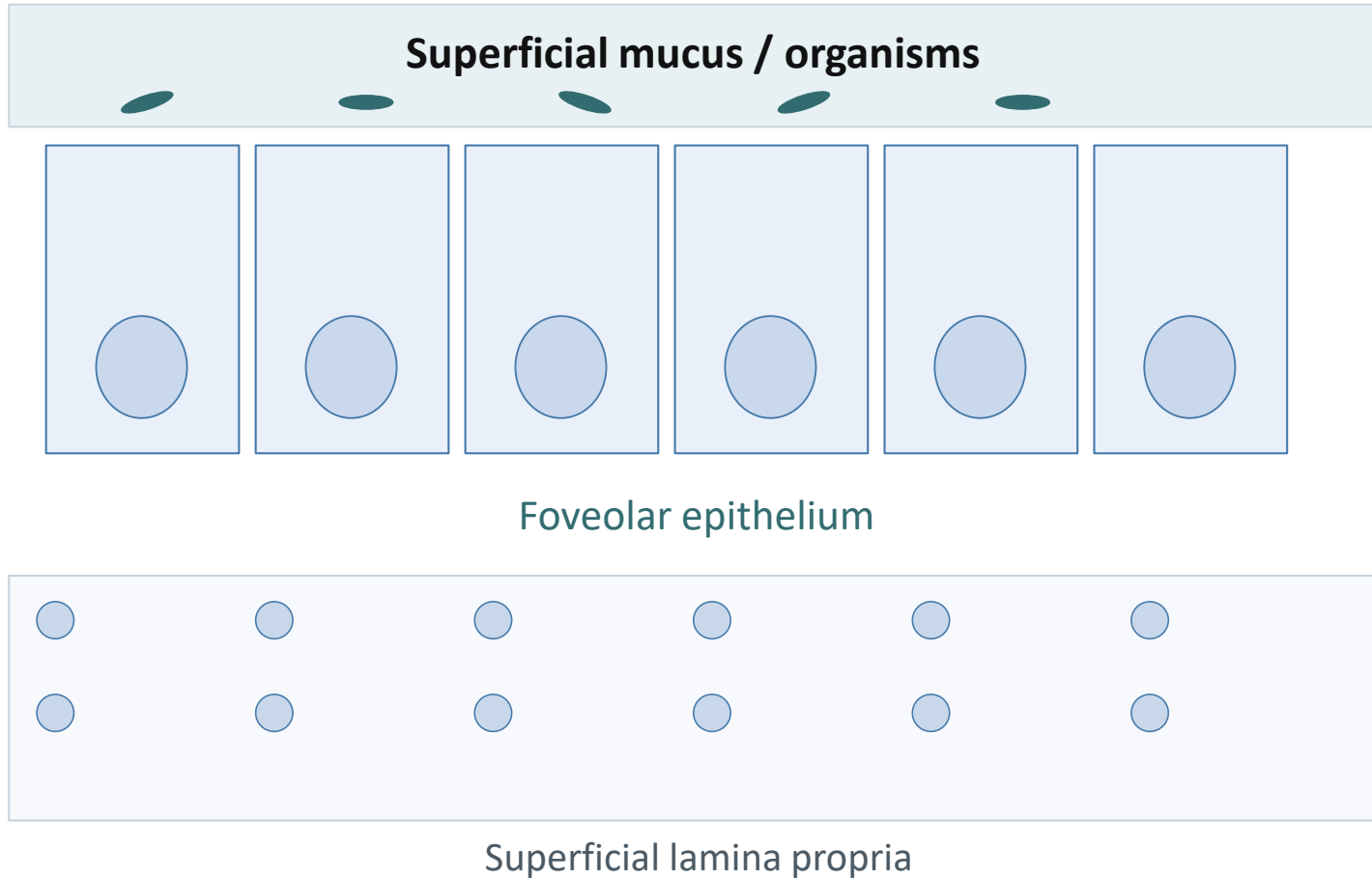
Intense inflammation may mimic neoplasia

- Severe inflammatory infiltrates can thicken gastric rugal folds.
- The resulting endoscopic appearance may resemble early cancer.
- Appearance alone cannot establish either inflammatory or malignant etiology.
- Histopathologic sampling resolves the morphologic differential.

Why antral sampling often detects infection



Organisms localize in superficial mucus



Mucosal surface niche

- Bacteria overlie surface and neck epithelium.
- Colonization can be dense near foveolar surfaces.
- Deep lamina propria is not the principal reservoir.

Original schematic; Not a photomicrograph

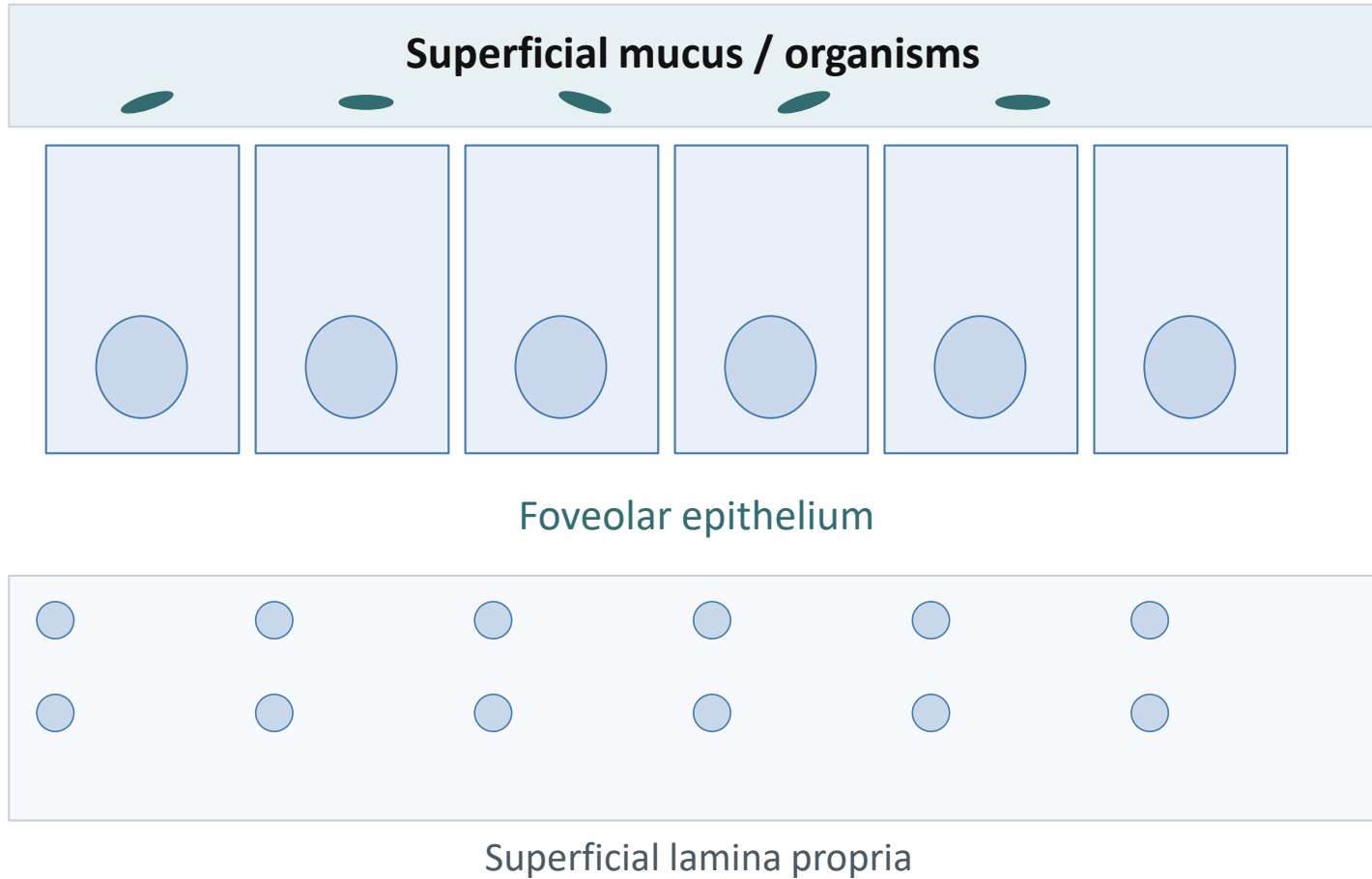
Bacterial distribution may be irregular

- Heavily colonized foci may adjoin sparsely colonized areas.
- Organisms are not evenly distributed across all gastric fragments.
- Negative appearance at one level does not establish universal absence.
- Site, sampling and organism-specific stains affect detection.

The principal histologic pattern is chronic active gastritis

- Chronicity: Plasma cells and lymphocytes in the lamina propria.
- Activity: Neutrophils infiltrate epithelium or glandular lumens.
- Additional clue: Mucosal lymphoid aggregates, sometimes germinal centers.
- Identification of bacteria strengthens etiologic attribution.

Superficial plasma-cell infiltrates are prominent



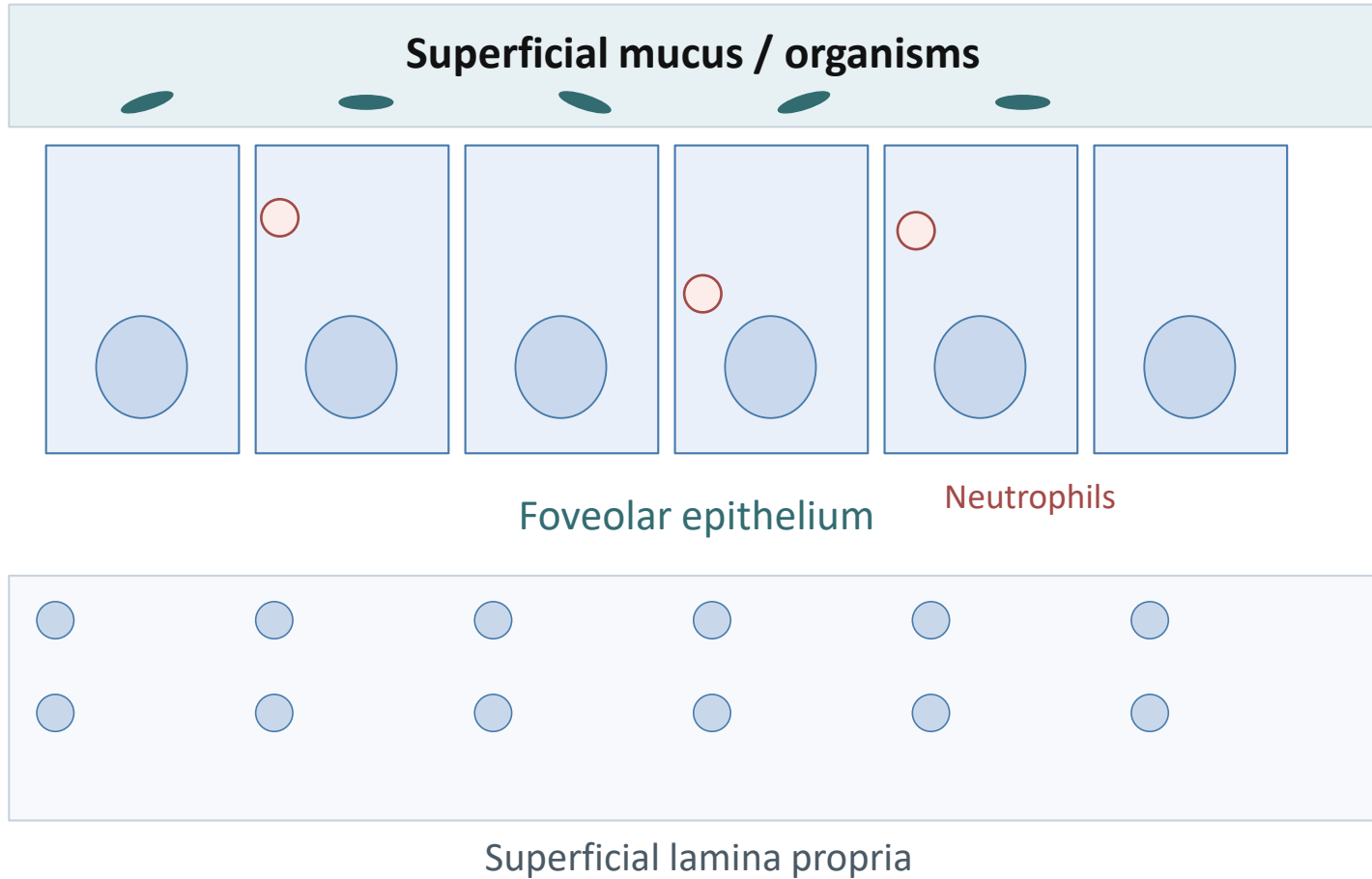
Chronic inflammation

- Plasma cells can form superficial clusters or sheets.
- Inflammation is often pronounced beneath epithelium.
- Pattern accompanies the organism-rich surface.

Lymphocytes and macrophages accompany plasma cells

- The lamina propria infiltrate is mixed rather than purely neutrophilic.
- Increased lymphocytes and macrophages accompany plasma cells.
- A chronic immune response develops during persistent colonization.
- These features are interpreted together with neutrophilic activity.

Neutrophils establish active epithelial injury

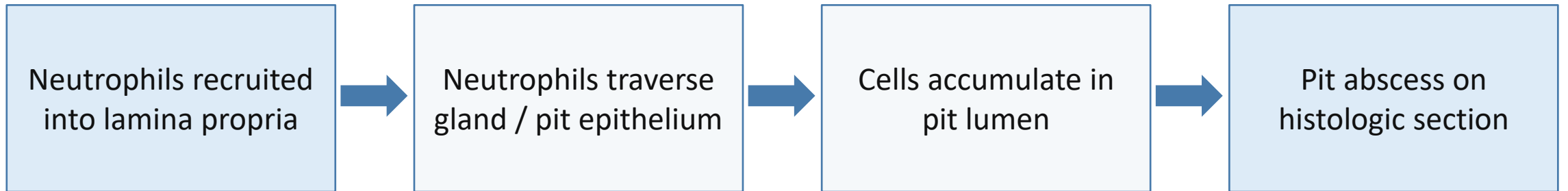


Neutrophilic activity

- Neutrophils migrate across the basement membrane.
- They infiltrate foveolar and glandular epithelium.
- Their presence marks active mucosal inflammation.

Original schematic; Not a photomicrograph

How a gastric pit abscess forms



“Pit abscess” refers to luminal inflammatory-cell accumulation; It is not a gross abscess cavity.

Histologic tools for organism detection

Stain / method	What it shows	Diagnostic contribution
Routine H&E	Sometimes visible curved organisms	Also assesses inflammatory architecture
Warthin–Starry silver	Dark organisms along superficial mucus	Histochemical enhancement
Immunohistochemistry	Organism-targeted staining	Often facilitates identification

A silver stain does not substitute for morphology

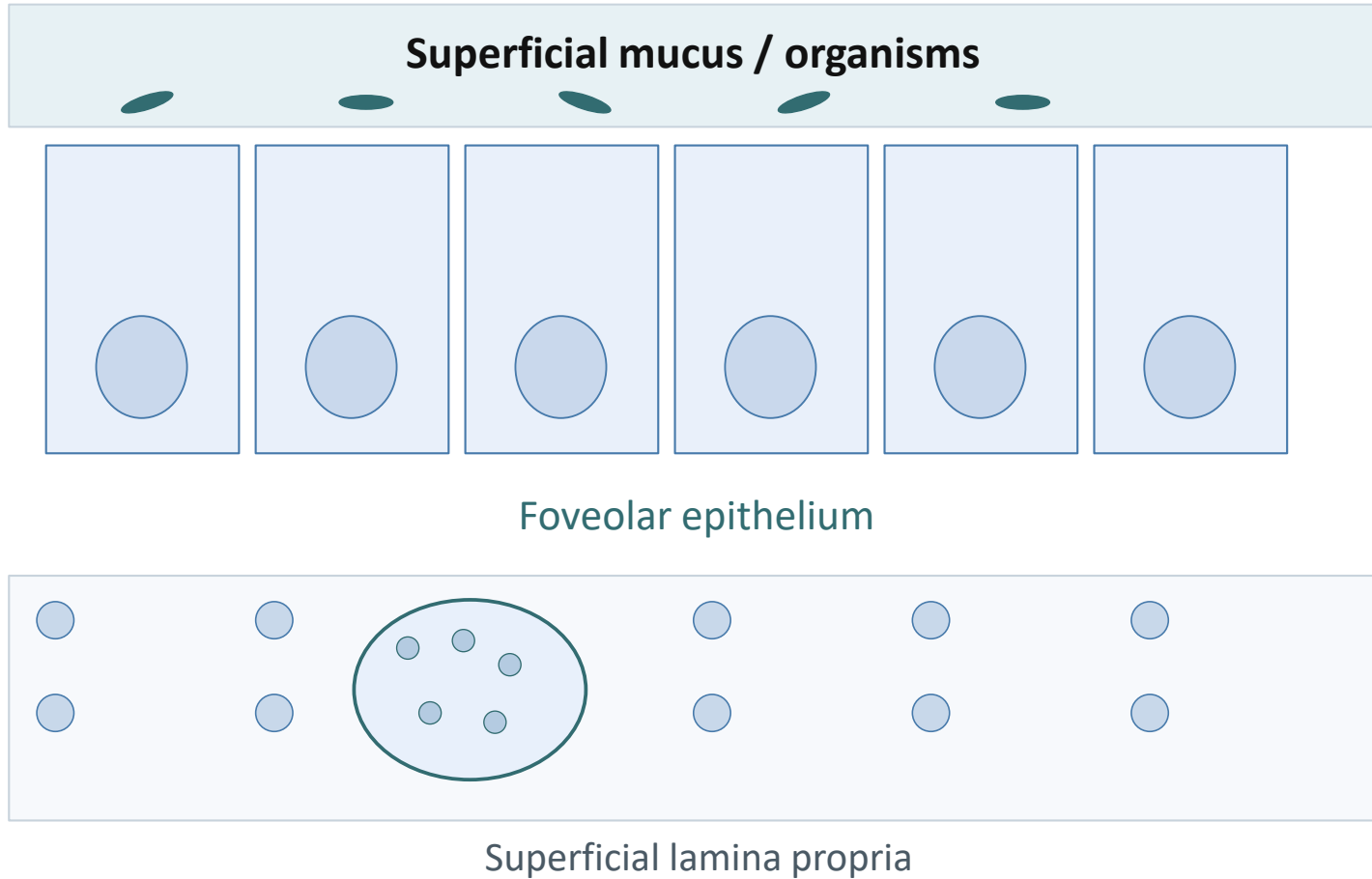
Warthin–Starry highlights bacteria; H&E establishes tissue response.

- Spiral organisms can be found within the surface mucus layer.
- Interpret bacterial staining alongside epithelial and stromal changes.
- Organism stains are interpreted with H&E tissue architecture.

Immunostaining improves organism recognition

- The source identifies organism-directed immunostains among preferred detection methods.
- They can help when organisms are inconspicuous on routine H&E.
- A positive stain must be localized to biologically plausible surface organisms.
- Interpret results with sample quality and distribution in mind.

Lymphoid follicles signal organized mucosal immunity

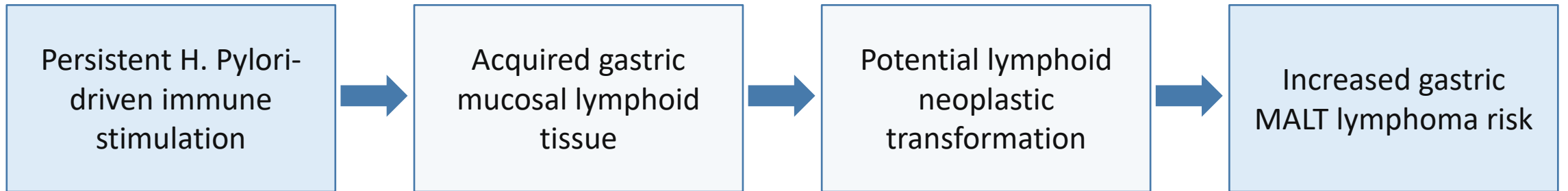


Induced mucosal MALT

- Lymphoid aggregates may include germinal centers.
- Plasma cells are abundant in adjacent lamina propria.
- Acquired lymphoid tissue forms in the infected mucosa.

Original schematic; Not a photomicrograph

From chronic infection to MALT lymphoma risk



Lymphoid aggregates are common reactive findings; They are not synonymous with lymphoma.

Integrated morphology checklist

Compartment	Recognizable change
Mucus / surface	Curved organisms, often irregularly distributed
Superficial lamina propria	Prominent plasma-cell-rich chronic inflammation
Foveolar epithelium / pits	Intraepithelial neutrophils and pit abscesses
Lymphoid compartment	Aggregates, sometimes with germinal centers

The biopsy diagnosis integrates several findings

- A surface-associated organism plus chronic active inflammation strongly supports H. Pylori gastritis.
- Lymphoid follicles add supportive context but are not obligatory.
- Intensity and topography of inflammation vary between biopsies.
- The tissue pattern also guides assessment of atrophy and metaplasia.

Topography helps separate two major gastritides

H. Pylori-associated

- Frequently antral-predominant
- May extend to body in advanced disease
- Often patchy atrophy

Autoimmune atrophic

- Predominantly body / corpus
- Antrum often spared
- Glandular atrophy of oxyntic mucosa

Different acid–gastrin signatures

H. Pylori-associated

- Acid normal, increased or modestly reduced
- Gastrin normal to increased
- Residual acid secretion can persist

Autoimmune atrophic

- Markedly impaired acid secretion
- Gastrin often markedly increased
- Parietal-cell destruction is central

Immune and serologic distinctions

H. Pylori-associated

- Bacterial colonization drives inflammation
- Anti-H. Pylori antibodies may be detected
- Parietal-cell autoantibodies not characteristic

Autoimmune atrophic

- Parietal-cell and intrinsic-factor autoimmunity
- H⁺/K⁺-ATPase antibodies may be present
- Intrinsic-factor loss causes B₁₂ deficiency

Contrasting clinical associations

H. pylori gastritis

Peptic ulcer disease

Gastric adenocarcinoma association

MALT lymphoma risk

Autoimmune atrophic gastritis

Pernicious anemia

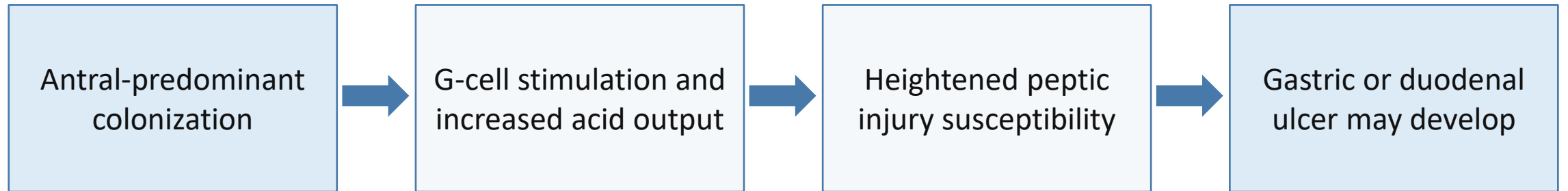
Gastric adenocarcinoma association

Neuroendocrine cell hyperplasia / carcinoid association

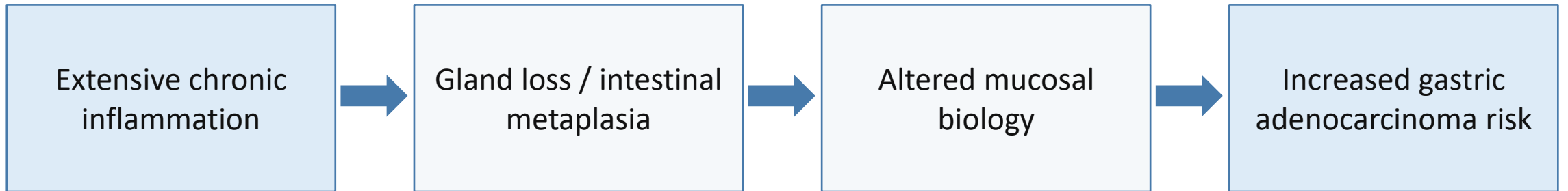
Clinical symptoms may be absent or nonspecific

- Acute infection is often unnoticed or causes mild symptoms.
- Patients may first be assessed during chronic gastritis or ulcer evaluation.
- The chronic histologic lesion can exist without prominent symptoms.
- Clinical history alone cannot prove ongoing bacterial colonization.

Linking chronic gastritis to peptic ulceration



Linking atrophic gastritis to neoplastic risk



This slide summarizes an association/pathway; It does not imply inevitable malignant transformation.

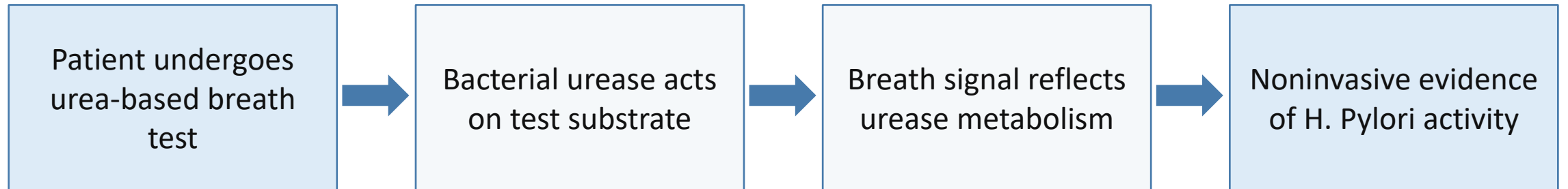
Major diagnostic test classes

Specimen / setting	Methods named by Robbins
Gastric biopsy	Histology, immunostains / histochemical stains
Gastric biopsy	Rapid urease test, bacterial culture, PCR
Noninvasive	Urea breath test, fecal detection
Blood	Serologic anti-H. pylori antibodies

Histology answers both etiologic and tissue questions

- Demonstrates the inflammatory pattern and organism localization.
- Assesses active injury, lymphoid aggregates and glandular atrophy.
- Can identify intestinal metaplasia when present.
- Sampling must account for irregular bacterial distribution.

Urea breath testing interrogates urease activity



Fecal tests detect bacterial material

The stool specimen offers a noninvasive route to organism detection.

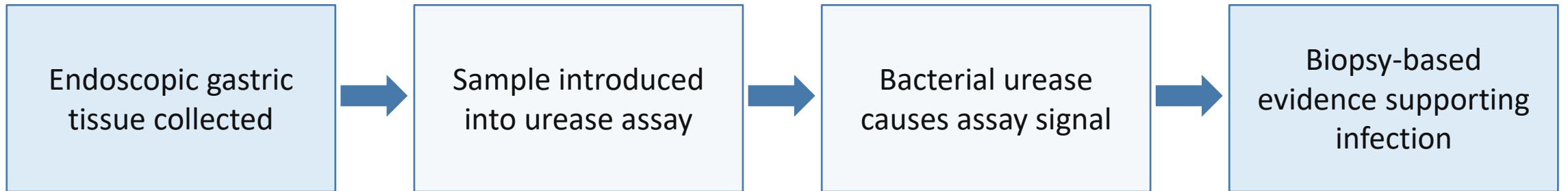
- Fecal bacterial detection is one noninvasive test class.
- The approach does not require gastric endoscopic sampling.
- The result should be interpreted in the clinical testing context.

Serologic testing detects a host response

Anti-*H. Pylori* antibody testing measures immune recognition.

- The blood test does not require endoscopic sampling.
- The measured target is a host antibody, not directly visualized bacteria.
- Serology and direct organism-detection approaches answer different questions.

Rapid urease testing uses biopsy material



Culture and molecular detection

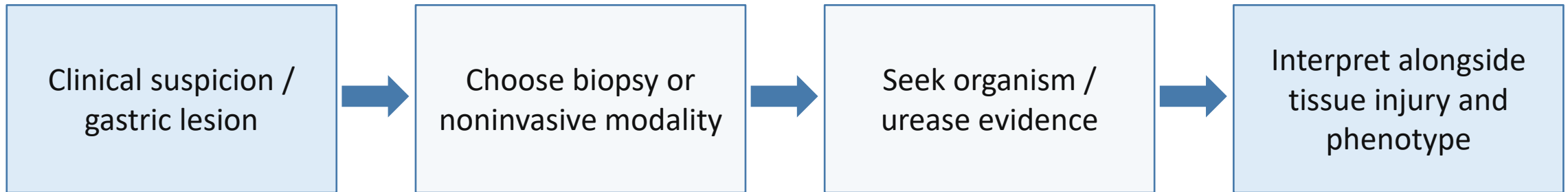
Bacterial culture

- Attempts recovery of viable gastric organisms
- Growth requires successful bacterial culture conditions
- Requires a gastric biopsy sample

PCR for H. Pylori DNA

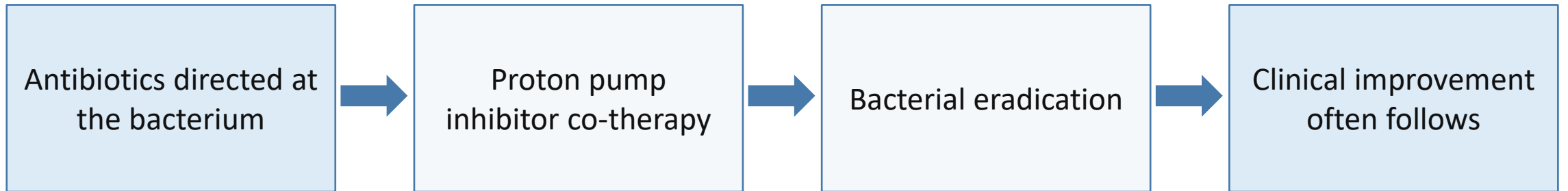
- Uses molecular detection of bacterial DNA
- Alternative biopsy-based approach
- Targets microbial nucleic acid rather than morphology

A practical diagnostic synthesis



Testing is selected by clinical context; The sequence shown is conceptual rather than a guideline.

Eradication addresses the causal infection



Specific regimens, duration and resistance guidance were not supplied in the source; None are asserted here.

Relapse and reinfection are distinct possibilities

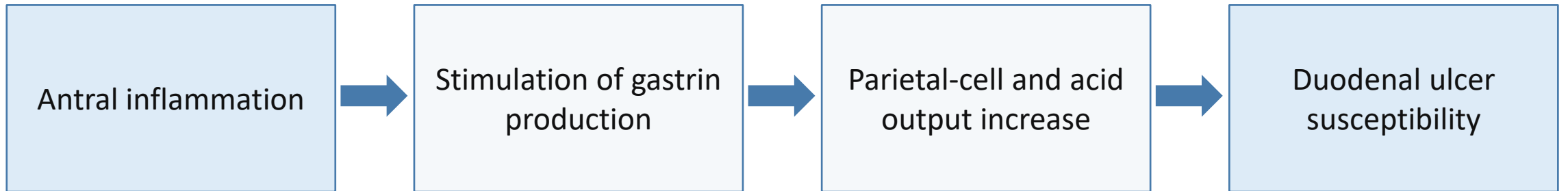
- Symptoms or infection may recur after incomplete eradication.
- Reinfection can also occur after successful treatment.
- Reinfection is particularly relevant in highly endemic settings.
- Persistent gastric disease requires appropriate clinical reassessment.

Case 1 — high-acid clinical phenotype

A patient with chronic H. Pylori antral gastritis develops a duodenal ulcer. Corpus parietal-cell function is preserved, with increased acid secretion.

Which causal sequence connects the antral lesion to ulcer risk?

Case 1 — mechanistic interpretation

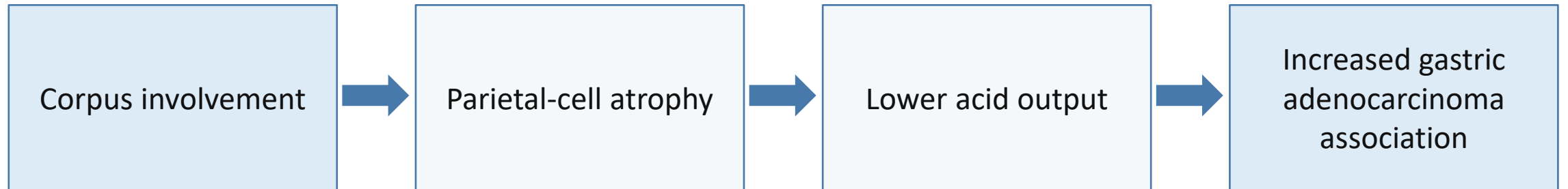


Case 2 — the atrophic phenotype

Gastric biopsies show long-standing inflammation extending beyond the antrum, patchy gland loss and intestinal metaplasia.

Which physiologic shift and long-term complication are associated with this pattern?

Case 2 — mechanistic interpretation



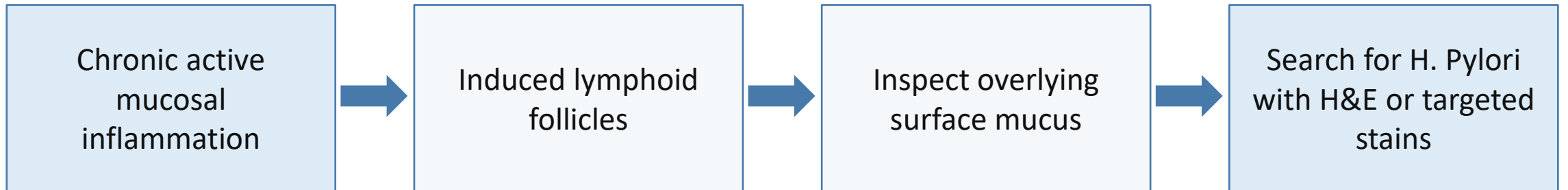
Compensatory gastrin may rise, but usually less than in autoimmune atrophic gastritis.

Case 3 — pattern recognition in a biopsy

Antral biopsy shows a superficial plasma-cell-rich infiltrate, neutrophils within glandular epithelium and follicles with germinal centers.

What etiologic diagnosis should be considered, and where should organisms be sought?

Case 3 — histologic interpretation



Integrated diagnostic–pathogenetic summary

The distribution of chronic active gastritis is the key organizing principle.

- Antrum → gastrin and high acid → peptic ulcer tendency.
- Extensive atrophic disease → low acid and metaplasia → cancer association.
- Superficial organisms, neutrophils, plasma cells and follicles unite the histology.
- Urease, organism detection and biopsy morphology provide complementary evidence.