Biomarkers are potential instruments in the toolbox of precision medicine in AD.

Precision medicine approaches may improve AD management because therapeutic response may vary based on heterogeneous clinical and molecular phenotypes.

**BIOMARKER DEFINITIONS**

A biological molecule found in blood, other body fluids, or tissues that can be used to follow body processes and diseases in humans and animals.

A defined characteristic that is measured as an indicator of normal biologic processes, pathogenic processes, or responses to an exposure or intervention, including therapeutic interventions.

**DEMANDING PROCESS OF BIOMARKER DEVELOPMENT AND VALIDATION**

**BIOMARKER DISCOVERY**

By chance or hypothesis-driven discovery using patient registries

**INTERNAL VALIDATION**

In a limited number of clinical cases

**EXTERNAL VALIDATION**

In a large cohort of patients

**REGULATORY QUALIFICATION**

Complex process supported by regulatory agency guidance

**USES OF POTENTIAL BIOMARKERS IDENTIFIED IN AD**

**IMPROVE DIAGNOSIS**

Eg: differentiate AD and psoriasis

**REFLECT DISEASE SEVERITY**

Eg: monitor treatment efficacy and motivate patient adherence

**PREDICT ONSET**

Eg: intervene early in high-risk neonates

**PREDICT RESPONSE**

Eg: disease-response and treatment-specific biomarkers guide treatment

**POTENTIAL BIOMARKERS FOR AD IN NONLESIONAL AND LESIONAL AD SKIN AND BLOOD**

**AD BIOMARKERS ACROSS DISEASE PHENOTYPES**

$T_n^2$ and $T_{n2}$ pathways commonly activated across AD subtypes, but specific biomarkers vary among different populations.

**DIFFERENT ETHNICITIES**

Eg: Asian biomarkers correlate with clinical phenotype: psoriasiform type lesions

**AD COMORBIDITIES**

Eg: biomarkers may reflect AD clinical severity and predict food allergy

**AGE-RELATED CHANGES**

Eg: elderly biomarkers reflect barrier defect; infant biomarkers similar to psoriasis

**S. aureus COLONIZATION**

Higher levels of type 2 biomarkers and more severe clinical parameters

**SAMPLES/TECHNIQUES FOR STUDYING AD BIOMARKERS**

- **Blood**
  - Relatively easy collection
  - May more objectively represent overall skin involvement
  - Changes may be subtle and/or take longer to occur
  - Some key biomarkers in skin not well detected (ie, CCL26/5/3/5/3)

- **Skin biopsy**
  - High detection rates
  - Locate barrier-related changes at specific areas
  - Immunohistochemistry studies reveal structural changes
  - Painful and scarring
  - Potential infections and poor healing

- **Tape strip**
  - Minimally invasive and nonscarring
  - Variable detection rate (50-100%) across studies
  - Capture barrier-related changes in early disease
  - Tissue processing is time-consuming/technically challenging
  - Cannot capture differences in skin depth, location of biomarkers, and structural changes

**CONCLUSIONS**

The potential of biomarkers in AD is yet to be fully elucidated. The review found that the chemokine with the greatest evidence-based support to become a potential AD biomarker, at both baseline and following therapy, is CCL17/TARC, a chemoattractant of TH2 cells. Studies using more minimally invasive techniques, such as tape-strips, in which biomarker dynamics are closely monitored in relation to therapeutic response are needed to improve the validity and relevance of biomarkers in AD.

Abbreviations: AD=atopic dermatitis, CCL=chemokine C, FDA=Food and Drug Administration, EMA-European Medicines Agency, EMA-EMA, IEC-biologic processes, pathogenic processes, or responses to an exposure or intervention, including therapeutic interventions.