SHAMIR MEDICAL CENTER

NEXT GENERATION

# Sequencing

## 2nd & 3rd Gen

שירותי ריצוף הדור השני והשלישי

- Whole Genome
- Whole Exome
- Targeted
- Clinical Oncology
- Transcriptome
- Microbiology & Metagenome
- Pharmacogenomics (PGx)
- Telomere — csTL
- NIPT

### PLATFORMS

PacBio Revio (HiFi long-read)

Illumina NovaSeq X Plus

Illumina NextSeq 500 · NextSeq DX

ISO 9001:2015 · Cert. No. 87968

Version 01

### NGS LABORATORY

מערכת איכות מאושרת ISO-9001

תעודה רישום מעבדה רפואית 4110X

# Committed to sequencing excellence

End-to-end long and short-read sequencing on one hospital campus. A clinically certified, single-source laboratory providing in-house library prep, sequencing, and bioinformatics for pharmacogenomics, microbiology, transcriptomics, and telomere biology.

## Service Portfolio

## פורטפוליו השירותים

| SERVICE | LIBRARY PREP | PLATFORM | STATUS |
|---|---|---|---|
| **LONG-READ · PACBIO REVIO** | | | |
| **Whole Genome T2T**<br>ריצוף גנום מלא | SMRTbell Prep 3.0 · SPRQ HiFi | PacBio Revio | RUO |
| **Targeted Panels**<br>פאנל של גנים לבחירתך | SPRQ Chem · PureTarget · Twist Alliance Dark Genes | PacBio Revio | RUO |
| **RNA Transcriptome**<br>טרנסקריפטום מלא | ISO-Seq 2.0 · Kinnex | PacBio Revio | RUO |
| **Microbiology & Metagenome**<br>מיקרוביולוגיה | Full-length 16S · Kinnex 16S · Metagenome profiling · Microbial WGS | PacBio Revio | RUO |
| **Pharmacogenomics (PGx)**<br>פרמקוגנומיקה | Twist long-read capture V2 | PacBio Revio | LDT |
| **Telomere — csTL**<br>אורך טלומר (csTL) | Twist subtelomeric capture | PacBio Revio | In development |
| **SHORT-READ · ILLUMINA NOVASEQ X** | | | |
| **Whole Genome**<br>ריצוף גנום מלא | Illumina WGS | NovaSeq X | RUO |
| **Whole Exome**<br>ריצוף אקסום | Illumina Twist | NovaSeq X | RUO |
| **Transcriptome**<br>טרנסקריפטום | Illumina Standard mRNA · Illumina miRNA · SMARTer smRNA-Seq | NovaSeq X | RUO |
| **SHORT-READ · ILLUMINA NEXTSEQ** | | | |
| **Clinical Oncology Panels**<br>פאנלים אונקולוגיים קליניים | Sophia DDM · TruSight Oncology 500 | NextSeq 500 | Clinical · קליני |
| **NIPT**<br>סקר טרום-לידתי | VeriSeq V2 (cfDNA) | NextSeq DX | Clinical · קליני |

Legend: **RUO**- Research use only · **LDT**- Lab-developed test · **Clinical**- by physician referral

# Services in detail

# פירוט הפתרונות הגנומיים

## PACBIO REVIO - LONG-READ

### Whole Genome T2T (SMRTbell 3.0 / SPRQ) — RUO

| BIOLOGICAL QUESTION | LIB PREP CHEMISTRY | SAMPLE INPUT | ORGANISM / TARGET | OUTPUT FORMAT |
|---|---|---|---|---|
| De novo assembly, Structural Variants detection, and comprehensive T2T mapping. and full allele phasing. | SMRTbell prep kit 3.0. | 500 ng HMW gDNA (using SPRQ chemistry). | Human, Animal, Plant | uBAM, fully phased |

| MULTIPLEX OPTIONS | DEPTH OF COVERAGE | TARGET DIN / RIN | SAMPLE REC. | QC STEPS |
|---|---|---|---|---|
| Typically 1–4 per Revio Cell. | 40X · 30X · 20X · 10x · target for human WGS. | DIN > 8.0 | Unfragmented HMW DNA. | Qubit dsDNA HS, TapeStation, Short Read Eliminator (SRE) QC. |

### Targeted Panels (PureTarget / Twist Dark Genes) — RUO

| BIOLOGICAL QUESTION | LIB PREP CHEMISTRY | SAMPLE INPUT | ORGANISM / TARGET | OUTPUT FORMAT |
|---|---|---|---|---|
| Resolving "dark" genomic regions, repeat expansions, large deletions, and CNVs. | PureTarget kit (CRISPR-Cas9 target enrichment) or Twist target enrichment. | Varies; typically 1–4 µg HMW gDNA for PureTarget/Twist captures. | Human (e.g., F8, RPGR, SMN1/2) | uBAM, VCF |

| MULTIPLEX OPTIONS | DEPTH OF COVERAGE | TARGET DIN / RIN | SAMPLE REC. | QC STEPS |
|---|---|---|---|---|
| 96 per SMRT Cell (PureTarget). | Ultra-high coverage over targeted regions (>100X-200X). | DIN > 8.0 | Unfragmented HMW DNA (no aggressive shearing). | Qubit dsDNA HS, TapeStation. |

### RNA Transcriptome (Iso-Seq 2.0 / Kinnex) — RUO

| BIOLOGICAL QUESTION | LIB PREP CHEMISTRY | SAMPLE INPUT | ORGANISM / TARGET | OUTPUT FORMAT |
|---|---|---|---|---|
| Full-length transcript discovery, isoform quantification, and RNA architecture. | Iso-Seq Express 2.0 Kit / Kinnex full-length RNA kit. | 300 ng total RNA. | Agnostic / Human | uBAM |

| MULTIPLEX OPTIONS | DEPTH OF COVERAGE | TARGET DIN / RIN | SAMPLE REC. | QC STEPS |
|---|---|---|---|---|
| 24 to 48-plex (using Kinnex adapters). | Measured in transcript reads; ~2.5M to 30M reads depending on kit/cell. | RIN ≥ 7.0. | High-quality total RNA. | Qubit RNA HS |

### Microbiology & Metagenomics - 16S — RUO

| BIOLOGICAL QUESTION | LIB PREP CHEMISTRY | SAMPLE INPUT | ORGANISM / TARGET | OUTPUT FORMAT |
|---|---|---|---|---|
| Microbiome profiling, species/strain-level 16S resolution, and microbial genome assembly. | Kinnex 16S kit / HiFi plex prep 96. | 20–200 ng amplicons (16S) / 50 ng gDNA (Microbial WGS). | Bacterial / Microbial communities | uBAM |

| MULTIPLEX OPTIONS | DEPTH OF COVERAGE | TARGET DIN / RIN | SAMPLE REC. | QC STEPS |
|---|---|---|---|---|
| Up to 384-plex (16S) or 96-plex (Microbial WGS). | 15X–50X (Microbial WGS) / >1,000X for amplicons. | GQN10kb≥7.0 (for shotgun gDNA). | High-quality extracted DNA or purified 16S amplicons. | Qubit dsDNA HS, TapeStation/Fragment Analyzer. |

### Pharmacogenomics (Twist PGx V2) — LTD

| BIOLOGICAL QUESTION | LIB PREP CHEMISTRY | SAMPLE INPUT | ORGANISM / TARGET | OUTPUT FORMAT |
|---|---|---|---|---|
| Resolving complex structural variants and novel star alleles (e.g., CYP2D6). | Kinnex 16S kit / HiFTwist Standard Hyb v2 Enrichment + SMRTbell prep 3.0.i plex prep 96. | 200–1000 ng HMW gDNA. | Human Pharmacogenes (49 genes) | BAM, VCF (Star alleles via Aldy) |

| MULTIPLEX OPTIONS | DEPTH OF COVERAGE | TARGET DIN / RIN | SAMPLE REC. | QC STEPS |
|---|---|---|---|---|
| Up to 384-plex (16S) or 96-plex (Microbial WGS). | 15X–50X (Microbial WGS) / >1,000X for amplicons. | GQN10kb≥7.0 (for shotgun gDNA). | High-quality extracted DNA or purified 16S amplicons. | Qubit dsDNA HS, TapeStation/Fragment Analyzer. |

**ABBREVIATIONS** **RUO** Research use only **LDT** Laboratory-developed test **TAT** Turnaround time **DIN** DNA integrity number **RIN** RNA integrity number **HMW** High-molecular-weight DNA

# Services in detail

# פירוט הפתרונות הגנומיים

## ILLUMINA PLATFORMS — ריצוף קצר והיברידי

### Whole Exome — RUO

| BIOLOGICAL QUESTION | LIB PREP CHEMISTRY | SAMPLE INPUT | ORGANISM / TARGET | OUTPUT FORMAT |
|---|---|---|---|---|
| Comprehensive whole-genome SNV and small indel detection. | PCR-free or standard Illumina DNA prep. | Extracted gDNA. | Human / Agnostic | FASTQ, VCF |
| **MULTIPLEX OPTIONS** | **DEPTH OF COVERAGE** | **TARGET DIN / RIN** | **SAMPLE REC.** | **QC STEPS** |
| ~4 samples per 1.5B NovaSeq X flow cell. | 30X target for human WGS. | Standard intact gDNA. | High-quality extracted DNA. | Library quantification, clustering optimization. |

### Whole Exome (Illumina Exome 2.0 / Twist) — RUO

| BIOLOGICAL QUESTION | LIB PREP CHEMISTRY | SAMPLE INPUT | ORGANISM / TARGET | OUTPUT FORMAT |
|---|---|---|---|---|
| Cost-effective variant detection restricted to protein-coding regions. | Illumina DNA Prep with Exome 2.0 Plus Enrichment. | Extracted gDNA. | Human | FASTQ, VCF |
| **MULTIPLEX OPTIONS** | **DEPTH OF COVERAGE** | **TARGET DIN / RIN** | **LIB PREP CHEMISTRY** | **QC STEPS** |
| ~41 samples per 1.5B NovaSeq X flow cell. | 100X target for human WES. | Standard intact gDNA. | High-quality extracted DNA. | Library quantification, post-enrichment QC. |

### Transcriptome (Standard / miRNA / SMARTer) — RUO

| BIOLOGICAL QUESTION | LIB PREP CHEMISTRY | SAMPLE INPUT | ORGANISM / TARGET | OUTPUT FORMAT |
|---|---|---|---|---|
| Differential gene expression or small RNA/miRNA profiling. | Illumina miRNA prep / SMARTer smRNA-Seq. | 1 ng to 500 ng Total RNA / Serum / Plasma. | Human / Agnostic | FASTQ, Counts |
| **MULTIPLEX OPTIONS** | **DEPTH OF COVERAGE** | **TARGET DIN / RIN** | **LIB PREP CHEMISTRY** | **QC STEPS** |
| Up to 384 unique dual indexes (UDI). | 5 to 10 Million reads per sample. | RIN $\geq$ 7.0 for mRNA; N/A for plasma miRNA. | Purified total RNA / isolated exosomes. | TapeStation |

### Oncology Panels (TSO 500 / Sophia DDM) — CLINICAL

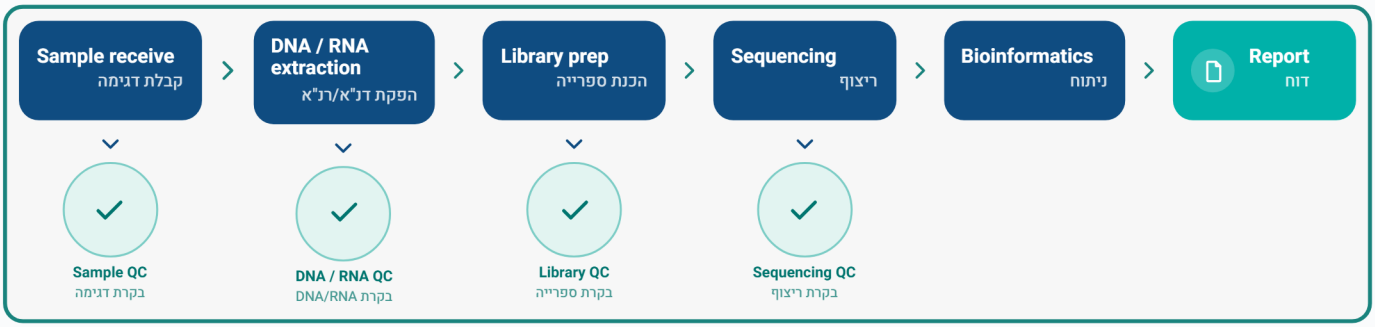
| BIOLOGICAL QUESTION | LIB PREP CHEMISTRY | SAMPLE INPUT | ORGANISM / TARGET | OUTPUT FORMAT |
|---|---|---|---|---|
| Comprehensive genomic profiling of solid tumors (TMB, MSI, SNVs, Fusions). | TruSight Oncology (Hybrid capture). Sophia DDM not detailed in docs. | FFPE Tissue (DNA and RNA). | Human (Solid Tumors) | FASTQ, VCF |
| **MULTIPLEX OPTIONS** | **DEPTH OF COVERAGE** | **TARGET DIN / RIN** | **LIB PREP CHEMISTRY** | **QC STEPS** |
| Not specified in uploaded docs. | Depend on Assay (general >1000X) | Variable (FFPE often highly degraded, DIN/RIN low). | FFPE scrolls or slides. | TapeStation and Qubit |

### NIPT (VeriSeq V2) — CLINICAL

| BIOLOGICAL QUESTION | LIB PREP CHEMISTRY | SAMPLE INPUT | ORGANISM / TARGET | OUTPUT FORMAT |
|---|---|---|---|---|
| Screening for fetal chromosomal aneuploidies (T21, T18, T13). | PCR-free, WGS-based cfDNA prep. | 7–10 mL maternal whole blood. | Human (cfDNA) | CSV report, custom clinical report |
| **MULTIPLEX OPTIONS** | **DEPTH OF COVERAGE** | **TARGET DIN / RIN** | **LIB PREP CHEMISTRY** | **QC STEPS** |
| 24, 48, or 96 samples per batch. | Low-pass WGS (0.1X – 0.3X). | High DIN indicates maternal cell lysis, which fails the run | Streck cfDNA Blood Collection Tubes. | Centrifugation volume check, Fetal Fraction calculation, cfDNA extraction QC. |

# Workflow

# תהליך העבודה




Process step · Quality checkpoint · Final deliverable

# Analysis & bioinformatics tools

# ניתוחים וכלים ביואינפורמטיים

| ANALYSIS | Revio | NovaSeq | NextSeq |
|---|---|---|---|
| Mapping / alignment | ● | ● | ● |
| SNV / indel calling | ● | ● | ● |
| CNV detection | ● | ● | ● |
| Structural variants | ● | ● | ○ |
| Methylation (CpG) | ● | ○ | — |
| Telomere length (Telogator2) | ● | — | — |
| Full-length isoforms | ● | ○ | — |
| 16S taxonomy & diversity | ● | — | — |
| Metagenome assembly | ● | ○ | — |
| PGx star-alleles | ● | ○ | ○ |
| cfDNA / NIPT | — | — | ● |

● available ○ in development / availability depends on application & reference

| STAGE | TOOLS |
|---|---|
| ALIGNMENT | BWA-MEM · BWA-MEM2 · pbmm2 · DRAGEN |
| VARIANT CALLING · SHORT READ | GATK HaplotypeCaller · FreeBayes · DeepVariant |
| SV / PHASING · LONG READ | pbsv · HiPhase |
| VCF / BAM POST-PROCESSING | bcftools · samtools / htslib · bedtools · picard · mosdepth |
| ANNOTATION | VEP · SnpEff / SnpSift · ClinVar · dbSNP · gnomAD |
| PRIORITIZATION / INTERPRETATION | Exomiser · PharmCAT · VarSeq VSPGx · pb-StarPhase · Pangu · Aldy · CypCaller |
| SPECIALIZED ANALYSIS | CNVkit · ExomeDepth · SpliceAI · HaploGrep · mity · IsoQuant · ISO-Seq / MAS-Seq |
| PYTHON LIBRARIES | pysam · cyvcf2 · pybedtools · pyvcf3 |
| PLATFORMS & WORKFLOW | Partek Flow · BSSH + bs CLI · WDL · Nextflow DSL2 · CWL · nf-core · AWS HealthOmics · ICA |

Production pipeline onPartek Flow; primary callersBWA-MEM,VEP,VarSeq VSPGx.

## What makes Shamir Genomics Laboratory unique

## מה מייחד את מעבדת הגנומיקה של שמיר

### Unrivaled Diagnostic Capabilities & Clinical Rigor

- First in Israel to unite long-read and short-read sequencing under one roof — a hybrid diagnostic edge.
- Resolves complex genetic regions standard testing misses, for superior pharmacogenomics and oncology accuracy.
- MoH-licensed and ISO-aligned — workflows and interpretation grounded in FDA, CPIC and ACMG standards.

### יכולות אבחון חסרות תקדים וקפדנות קלינית

- המעבדה הראשונה בישראל המאחדת ריצוף long-read ו-short-read תחת קורת גג אחת — יתרון אבחוני היברידי.
- פותרת אזורים גנטיים מורכבים שבדיקות סטנדרטיות מפספסות, לדיוק מרבי בפרמקוגנומיקה ובאונקולוגיה.
- ברישיון משרד הבריאות ותואמת ISO — תהליכים ופענוח לפי תקני FDA, CPIC ו-ACMG.

### Expert Leadership & Flexible Partnerships

- Directed by senior PhD-level medical-genetics scientists with a skilled multidisciplinary team.
- Adaptable service model shaped around your specific clinical or research goals.
- End-to-end clinical diagnostics, B2B sequencing (FASTQ / VCF), or research-collaboration support.

### מנהיגות מומחית ושיתופי פעולה גמישים

- בניהול מדעני גנטיקה רפואית בכירים בעלי תואר דוקטור, בגיבוי צוות רב-תחומי מיומן.
- מודל שירות גמיש המותאם למטרות הקליניות או המחקריות הייחודיות שלך.
- אבחון קליני מקצה לקצה, ריצוף B2B או תמיכה בשיתופי פעולה מחקריים.

# Platforms & Partners

# פלטפורמות ושותפים

POWERED BY

illumina® PacBio

SOPHiA GENETICS™ TWIST BIOSCIENCE GOLDEN HELIX Enabling Precision Medicine

ASSOCIATED WITH TEL AVIV UNIVERSITY אוניברסיטת תל אביב

## PLATFORMS · פלטפורמות

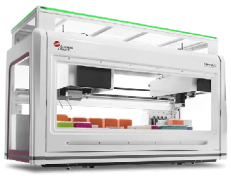
**PacBio Revio**
*"The Beauty"*
HiFi long-read

**Illumina MiSeq**
*"The Baby"*
Targeted panels · amplicon

**Illumina NextSeq 550Dx**
*"The Clinician"*
Clinical · NIPT · TSO 500

**Illumina NovaSeq X Plus**
*"The Beast"*
Short-read · high throughput

## AUTOMATION · אוטומציה



**Beckman Biomek i7**
*"The Octopus"*
Library-prep automation


**Hamilton Microlab STAR**
*"The Workhorse"*
Liquid-handling automation

SHAMIR MEDICAL CENTER

**Shamir (Assaf Harofeh) Medical Center**
NGS Laboratory · Division of Laboratories · Tzrifin, Be'er Ya'akov, Israel
מעבדת NGS · אגף המעבדות
ד"ר יוני זהבי, מנהל יחידת NGS ומנהל יחידה פתולוגיה מולקולרית
ד"ר חן ויינר, מנהל יחידת NGS, ומנהל QA אגף מעבדות
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