Step : 1 Upload All Four Source Files

In [12]:
```
from google.colab import files
uploaded = files.upload()
```

Choose Files No file chosen Upload widget is only available when the cell has been executed in the current browser session. Please rerun this cell to enable.

```
Saving ANC4_long.xlsx to ANC4_long.xlsx
Saving WPP2022_GEN_F01_DEMOGRAPHIC_INDICATORS_COMPACT_REV1.xlsx to WPP2022_GEN_F01_DEMOGRAPHIC_INDICATORS_COMPACT_REV1.xlsx
Saving On-track and off-track countries.xlsx to On-track and off-track countries.xlsx
Saving SBA_long.xlsx to SBA_long.xlsx
```

Step 2: Load & Clean Population Projections (2022)

In [13]:
```
# Load Projections sheet, skipping metadata rows
proj_df = pd.read_excel(
    "WPP2022_GEN_F01_DEMOGRAPHIC_INDICATORS_COMPACT_REV1.xlsx",
    sheet_name="Projections",
    skiprows=16
)

# Filter to 2022, Medium variant, country/area
proj_2022 = proj_df[
    (proj_df['Year'] == 2022) &
    (proj_df['Variant'] == 'Medium') &
    (proj_df['Type'] == 'Country/Area')
][[
    'Region, subregion, country or area *',
    'ISO3 Alpha-code',
    'Births (thousands)'
]].rename(columns={
    'Region, subregion, country or area *': 'Country',
    'ISO3 Alpha-code': 'ISO3',
    'Births (thousands)': 'Births_Thousands'
})

proj_2022['Births'] = proj_2022['Births_Thousands'] * 1000
proj_2022 = proj_2022.dropna(subset=['ISO3'])

display(proj_2022.head())
```

	Country	ISO3	Births_Thousands	Births
1900	Burundi	BDI	439.648	439648.0
1979	Comoros	COM	24.201	24201.0
2058	Djibouti	DJI	24.549	24549.0
2137	Eritrea	ERI	104.981	104981.0
2216	Ethiopia	ETH	3928.445	3928445.0

Step 3: Load & Process U5MR Status

In [14]:
```
status_df = pd.read_excel("On-track and off-track countries.xlsx")
status_df = status_df.rename(columns={
    'ISO3Code': 'ISO3',
    'OfficialName': 'Country_Name',
    'Status.U5MR': 'U5MR_Status'
})

status_df['Group'] = status_df['U5MR_Status'].str.lower()\
                  .map(lambda x: 'On-track' if x in ['on-track','achieved'] else 'O


merged_df = proj_2022.merge(status_df[['ISO3','Group']], on='ISO3', how='inner')
display(merged_df.head())
```

	Country	ISO3	Births_Thousands	Births	Group
0	Burundi	BDI	439.648	439648.0	Off-track
1	Comoros	COM	24.201	24201.0	Off-track
2	Djibouti	DJI	24.549	24549.0	Off-track
3	Eritrea	ERI	104.981	104981.0	Off-track
4	Ethiopia	ETH	3928.445	3928445.0	Off-track

Step 4: Load & Clean ANC4 and SBA

In [15]:
```
def clean_indicator(path, value_name):
    df = pd.read_excel(path, sheet_name="Unicef data")
    df = df[
        (df["Sex"] == "Total") &
        (df["TIME_PERIOD"].between(2018, 2022)) &
        (~df["Geographic area"].str.startswith("("))
    ]
    latest = (df.sort_values("TIME_PERIOD")
              .drop_duplicates("Geographic area", keep="last")
              .loc[:, ["Geographic area", "OBS_VALUE"]]
              .rename(columns={
                  "Geographic area": "Country",
```

```
                    "OBS_VALUE": value_name
                }))
    return latest

anc4_latest = clean_indicator("ANC4_long.xlsx", "ANC4")
sba_latest  = clean_indicator("SBA_long.xlsx", "SBA")

display(anc4_latest.head(), sba_latest.head())
```

	Country	ANC4
76	Cabo Verde	85.6
78	Cameroon	64.9
349	Papua New Guinea	49.0
117	Costa Rica	94.1
301	Montenegro	94.2

	Country	SBA
748	Venezuela (Bolivarian Republic of)	98.7
711	Tunisia	99.5
564	Papua New Guinea	56.4
488	Mongolia	99.3
489	Montenegro	98.8

Step 5: Merge All & Compute Weighted Coverage

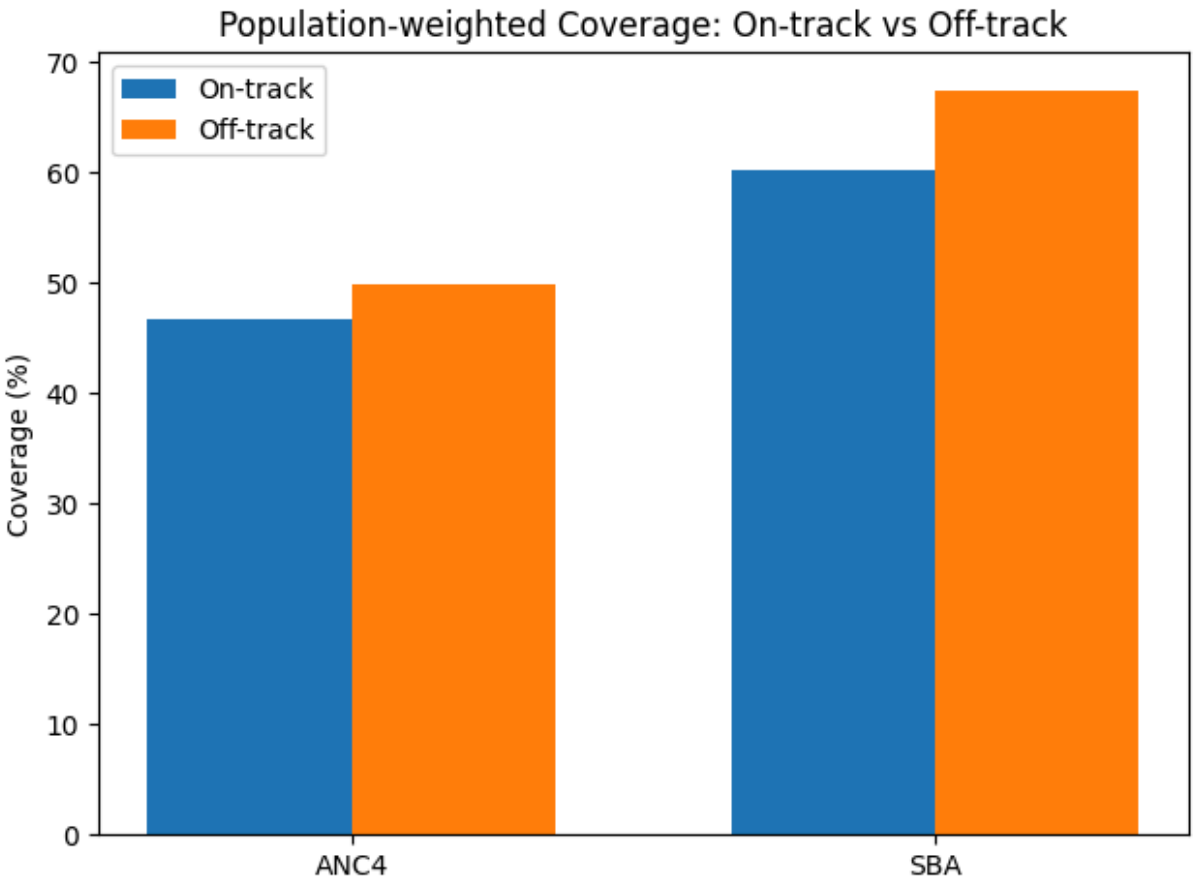
In [16]:
```
df = merged_df.merge(anc4_latest, on="Country", how="left")\
              .merge(sba_latest,  on="Country", how="left")

for service in ["ANC4","SBA"]:
    for grp in ["On-track","Off-track"]:
        sub = df[df["Group"] == grp]
        wavg = (sub[service] * sub["Births"]).sum() / sub["Births"].sum()
        print(f"{service} ({grp}): {wavg:.1f}%")
```

```
ANC4 (On-track): 46.7%
ANC4 (Off-track): 49.9%
SBA (On-track): 60.3%
SBA (Off-track): 67.5%
```

Step 6: Visualize the Results

In [17]:
```
import numpy as np
import matplotlib.pyplot as plt
```

```
# Services and values
services = ["ANC4", "SBA"]
ontrack = [46.7, 60.3]
offtrack = [49.9, 67.5]

x = np.arange(len(services))
width = 0.35

fig, ax = plt.subplots()
ax.bar(x - width/2, ontrack, width, label="On-track")
ax.bar(x + width/2, offtrack, width, label="Off-track")

ax.set_xticks(x)
ax.set_xticklabels(services)
ax.set_ylabel("Coverage (%)")
ax.set_title("Population-weighted Coverage: On-track vs Off-track")
ax.legend()

plt.tight_layout()
plt.show()
```



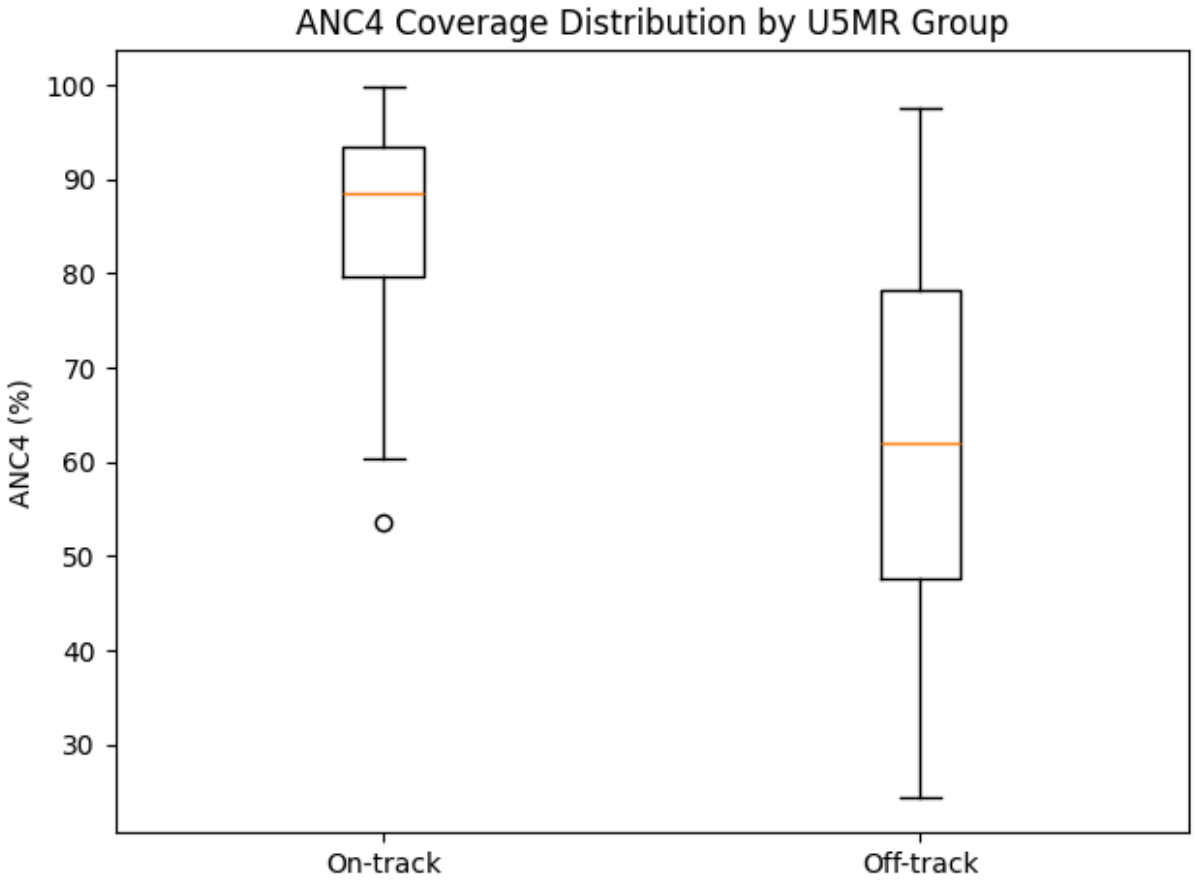
Additional Visualizations

Distribution Boxplots by Group

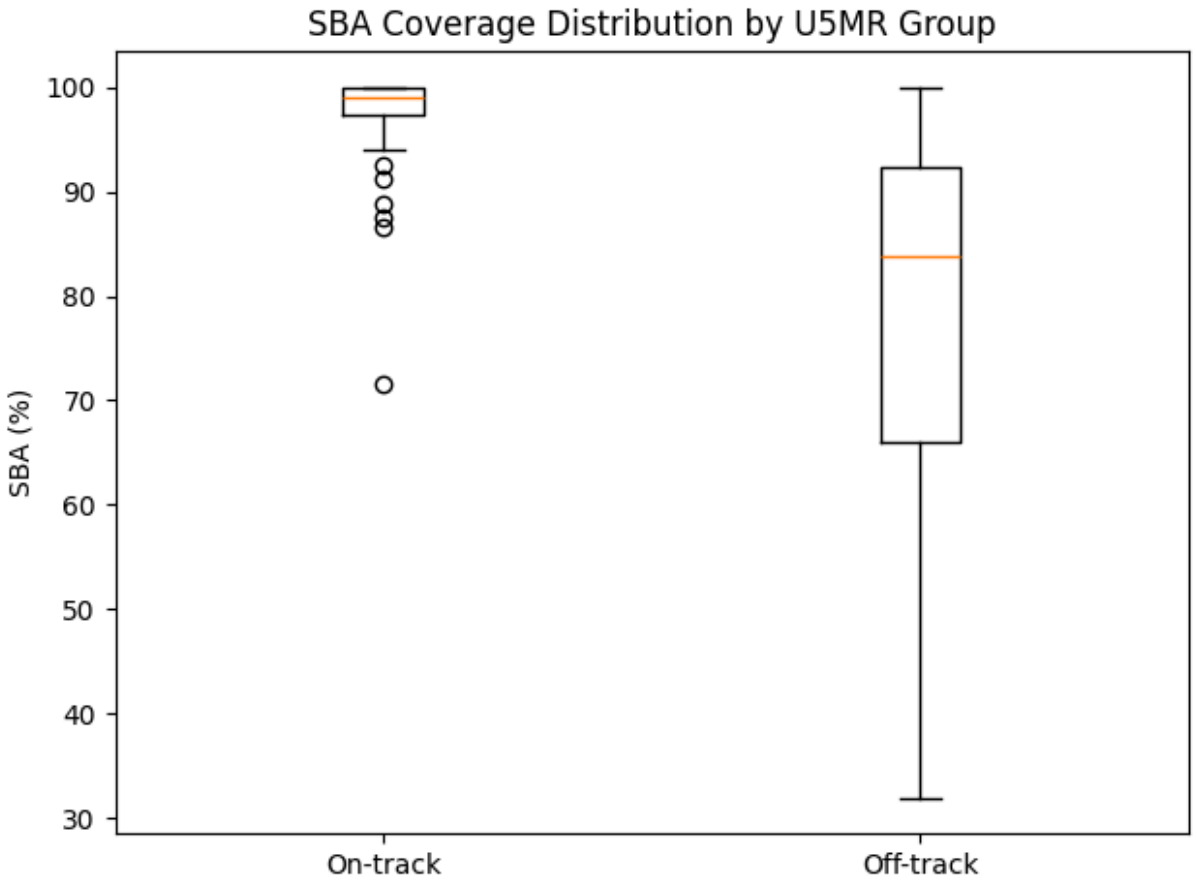
- This shows you the spread of country-level ANC4 and SBA coverages for On-track vs Off-track.

In [18]:
```
import matplotlib.pyplot as plt

anc4_on  = df.loc[df["Group"]=="On-track",  "ANC4"].dropna()
anc4_off = df.loc[df["Group"]=="Off-track", "ANC4"].dropna()

sba_on   = df.loc[df["Group"]=="On-track",  "SBA"].dropna()
sba_off  = df.loc[df["Group"]=="Off-track", "SBA"].dropna()

# ANC4
plt.figure()
plt.boxplot([anc4_on, anc4_off], labels=["On-track","Off-track"])
plt.title("ANC4 Coverage Distribution by U5MR Group")
plt.ylabel("ANC4 (%)")
plt.tight_layout()
plt.show()

# SBA
plt.figure()
plt.boxplot([sba_on, sba_off], labels=["On-track","Off-track"])
plt.title("SBA Coverage Distribution by U5MR Group")
plt.ylabel("SBA (%)")
plt.tight_layout()
plt.show()
```

```
/tmp/ipython-input-18-3720530496.py:12: MatplotlibDeprecationWarning: The 'labels' p
arameter of boxplot() has been renamed 'tick_labels' since Matplotlib 3.9; support f
or the old name will be dropped in 3.11.
  plt.boxplot([anc4_on, anc4_off], labels=["On-track","Off-track"])
```



```
/tmp/ipython-input-18-3720530496.py:20: MatplotlibDeprecationWarning: The 'labels' p
arameter of boxplot() has been renamed 'tick_labels' since Matplotlib 3.9; support f
or the old name will be dropped in 3.11.
  plt.boxplot([sba_on, sba_off], labels=["On-track","Off-track"])
```

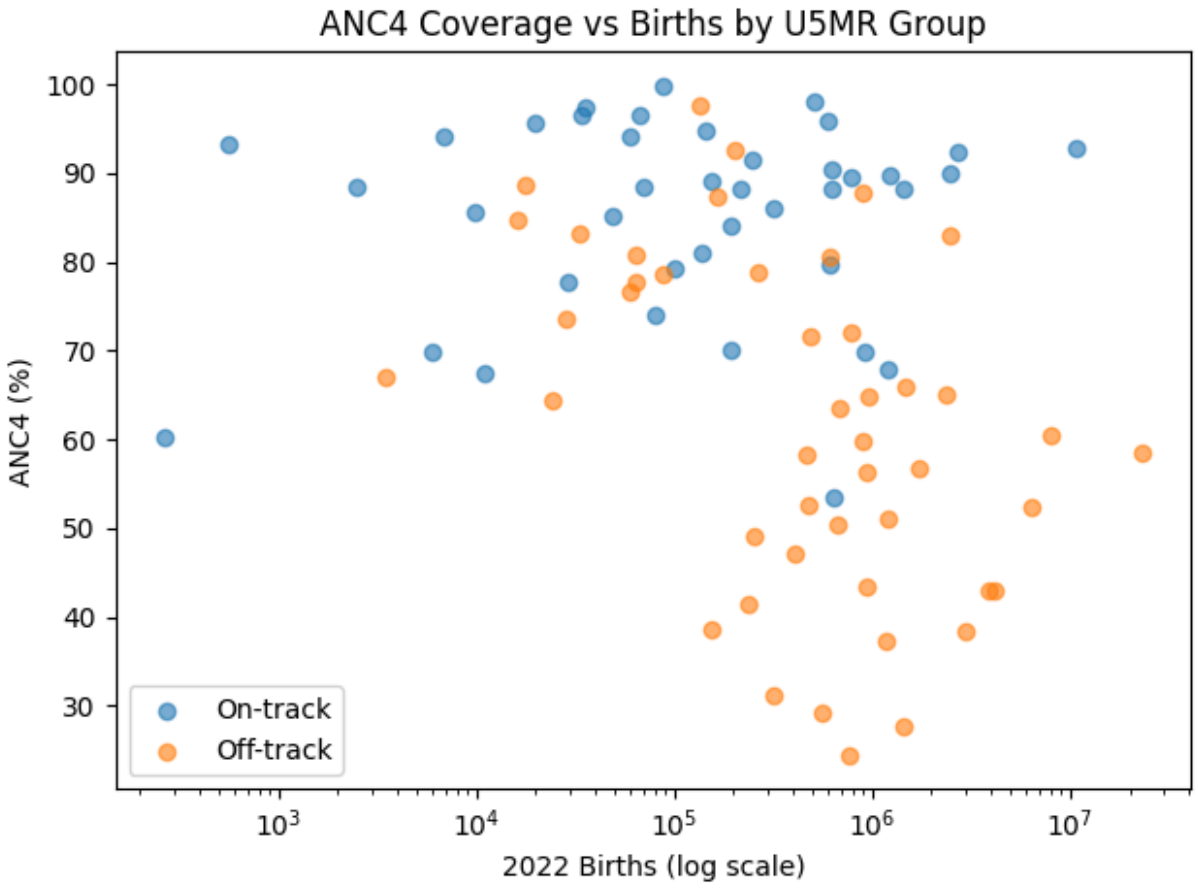


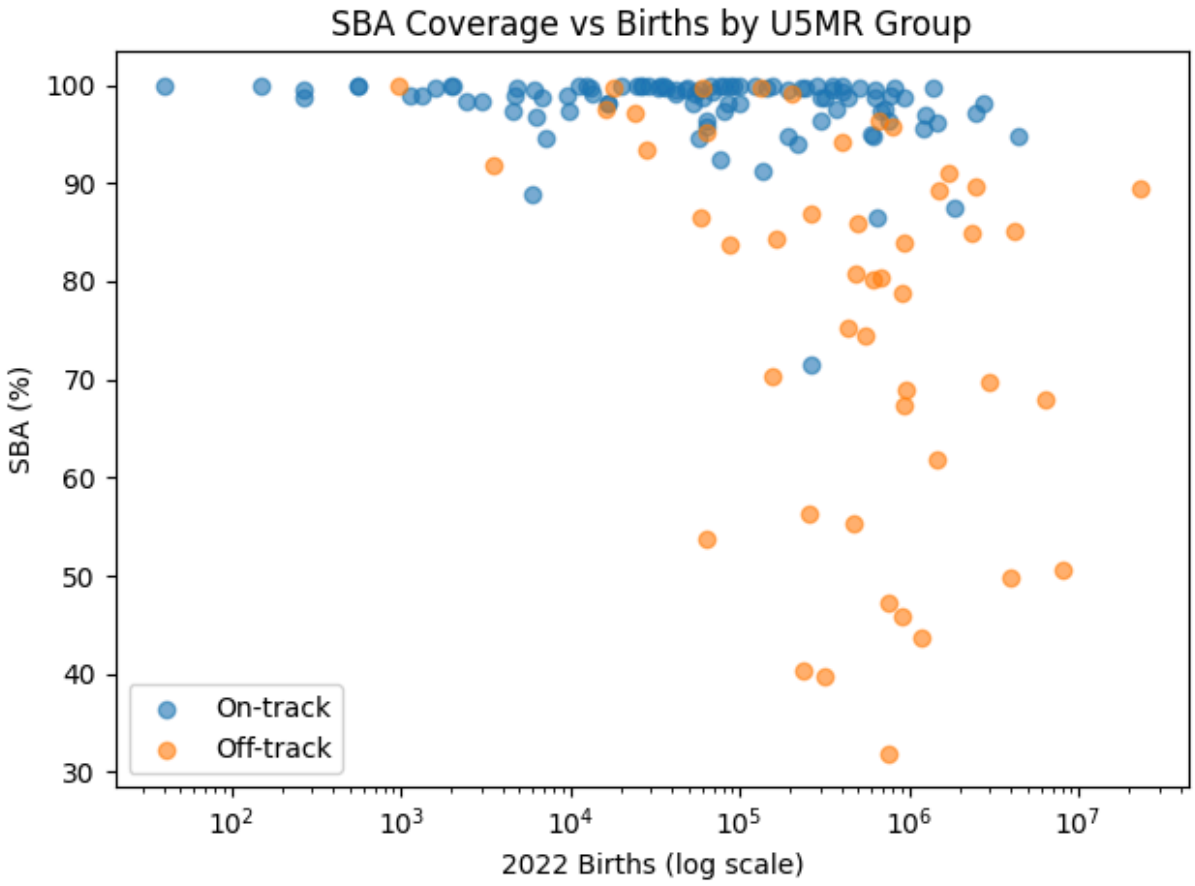
Scatter of Coverage vs. Births

- This helps you see whether country size (birth count) correlates with coverage, colored by group.

In [19]:
```
# ANC4
plt.figure()
for grp, color in [("On-track","C0"), ("Off-track","C1")]:
    sub = df[df["Group"]==grp]
    plt.scatter(sub["Births"], sub["ANC4"], label=grp, alpha=0.6)
plt.xscale("log")
plt.xlabel("2022 Births (log scale)")
plt.ylabel("ANC4 (%)")
plt.title("ANC4 Coverage vs Births by U5MR Group")
plt.legend()
plt.tight_layout()
plt.show()

# SBA
plt.figure()
for grp, color in [("On-track","C0"), ("Off-track","C1")]:
    sub = df[df["Group"]==grp]
    plt.scatter(sub["Births"], sub["SBA"], label=grp, alpha=0.6)
```

```
plt.xscale("log")
plt.xlabel("2022 Births (log scale)")
plt.ylabel("SBA (%)")
plt.title("SBA Coverage vs Births by U5MR Group")
plt.legend()
plt.tight_layout()
plt.show()
```





In [ ]:

Interpretation

Population-weighted ANC4 coverage is slightly higher in off-track countries (49.9%) than in on-track ones (46.7%), suggesting that even where under-five mortality improvements lag, antenatal service uptake remains relatively strong—possibly due to targeted maternal health programs. Conversely, SBA coverage shows a larger gap (67.5% vs. 60.3%), indicating that skilled birth attendance is more consistently available in countries ahead on mortality targets. **Caveats & Assumptions:**

- We used 2022 medium-variant birth projections from the UN WPP "Projections" sheet.
- ANC4/SBA values reflect the most recent data between 2018–2022, which may vary by country in terms of exact year.
- Country names/ISO3 matching may omit a few small territories if identifiers didn't align exactly.

In [27]:
```
!ls -1
```

```
ANC4_long.xlsx
drive
'On-track and off-track countries.xlsx'
outputs
sample_data
SBA_long.xlsx
WPP2022_GEN_F01_DEMOGRAPHIC_INDICATORS_COMPACT_REV1.xlsx
```

In [ ]:
```python
# 1) Mount Google Drive
from google.colab import drive
drive.mount('/content/drive')
```

In [ ]:
```python

```