In [6]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score, precision_score, recall_score, f1_score

# Load dataset
df = pd.read_csv('../Datasets/diabetes.csv')
M=len(df)
print(f"Loaded {M} samples.") # rather than a random "768" I will add addtional inf
# from here I can go ahead and make the data provided easier to read and make sure
print(df.head()) # from the df.head() I went ahead and added print to make it show
```

```
Loaded 768 samples.
   Pregnancies  Glucose  BloodPressure  SkinThickness  Insulin   BMI  \
0            6      148             72             35        0  33.6
1            1       85             66             29        0  26.6
2            8      183             64              0        0  23.3
3            1       89             66             23       94  28.1
4            0      137             40             35      168  43.1

   DiabetesPedigreeFunction  Age  Outcome
0                     0.627   50        1
1                     0.351   31        0
2                     0.672   32        1
3                     0.167   21        0
4                     2.288   33        1
```

In [2]:
```
df.describe()
```

Out[2]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	Dia
count	768.000000	768.000000	768.000000	768.000000	768.000000	768.000000	
mean	3.845052	120.894531	69.105469	20.536458	79.799479	31.992578	
std	3.369578	31.972618	19.355807	15.952218	115.244002	7.884160	
min	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	
25%	1.000000	99.000000	62.000000	0.000000	0.000000	27.300000	
50%	3.000000	117.000000	72.000000	23.000000	30.500000	32.000000	
75%	6.000000	140.250000	80.000000	32.000000	127.250000	36.600000	
max	17.000000	199.000000	122.000000	99.000000	846.000000	67.100000	

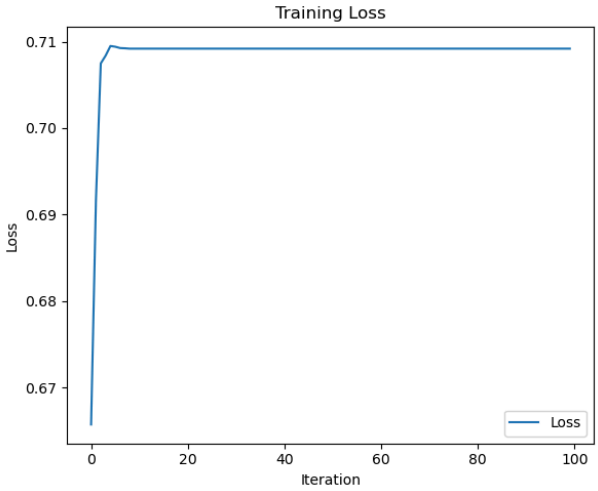
In [12]:
```
# Suppress convergence warnings
import warnings
from sklearn.exceptions import ConvergenceWarning
warnings.filterwarnings("ignore", category=ConvergenceWarning)
```

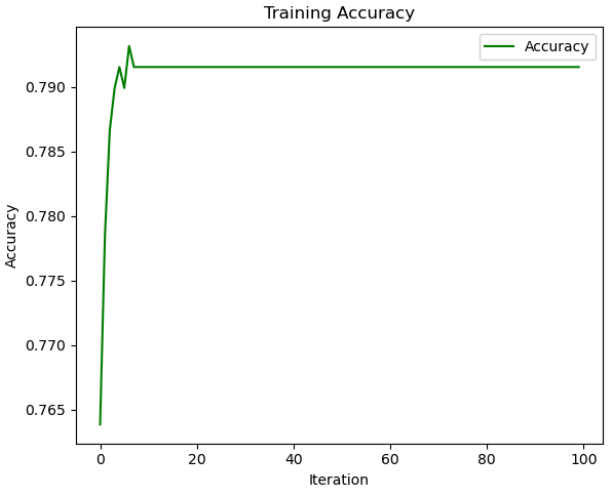
```
# Prepare data
X = df.drop("Outcome", axis=1)
y = df["Outcome"]

# Standardize features
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)

# Split into train and test sets (80/20)
X_train, X_test, y_train, y_test = train_test_split(
    X_scaled, y, test_size=0.2, random_state=42, stratify=y
)

# Initialize model
model = LogisticRegression(max_iter=1000)

# Track loss and accuracy during training
losses, accuracies = [], []

for i in range(1, 101):
    model.max_iter = i
    model.fit(X_train, y_train)

    logits = model.decision_function(X_train)
    loss = np.mean(np.log(1 + np.exp(-y_train * logits)))
    acc = accuracy_score(y_train, model.predict(X_train))

    losses.append(loss)
    accuracies.append(acc)

# Evaluate final model on test set
y_pred = model.predict(X_test)
acc_test = accuracy_score(y_test, y_pred)
prec = precision_score(y_test, y_pred)
rec = recall_score(y_test, y_pred)
f1 = f1_score(y_test, y_pred)
```

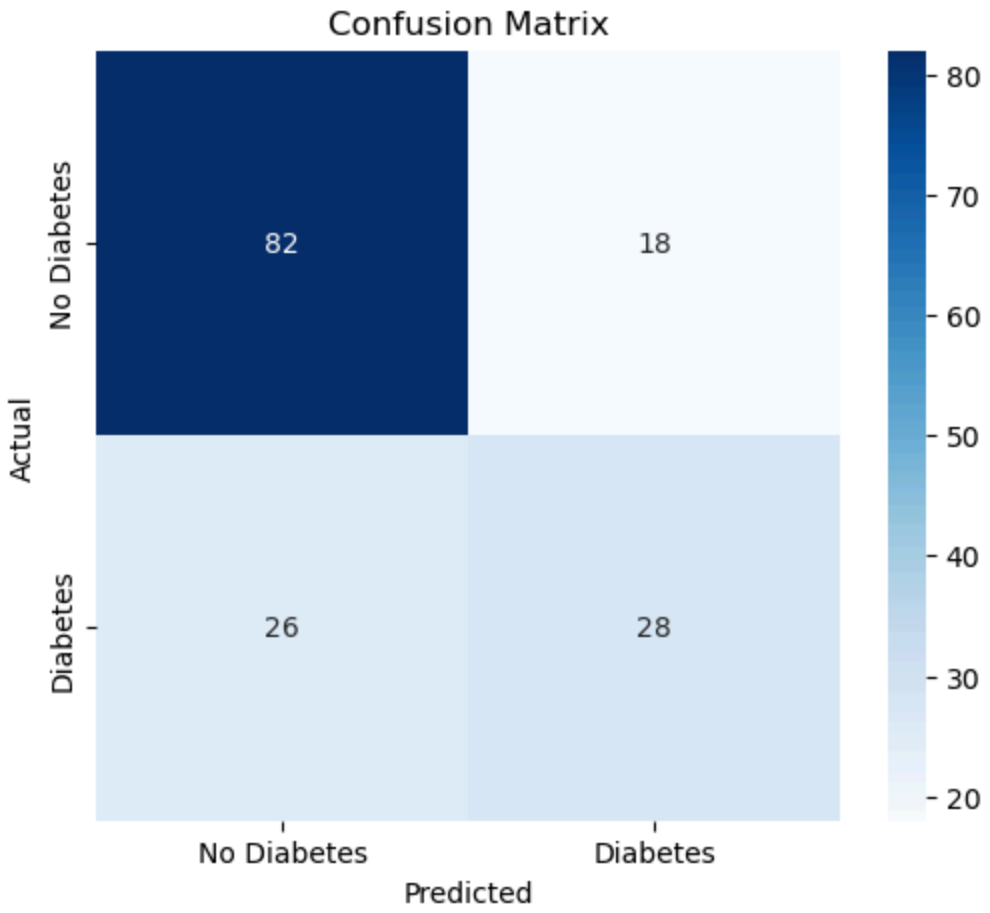
In [13]:

```
# Plot training metrics
plt.figure(figsize=(12, 5))

# Loss plot
plt.subplot(1, 2, 1)
plt.plot(losses, label='Loss')
plt.xlabel('Iteration')
plt.ylabel('Loss')
plt.title('Training Loss')
plt.legend()

# Accuracy plot
plt.subplot(1, 2, 2)
plt.plot(accuracies, label='Accuracy', color='green')
plt.xlabel('Iteration')
plt.ylabel('Accuracy')
plt.title('Training Accuracy')
plt.legend()
```

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

# Confusion matrix
plt.figure(figsize=(6, 5))
sns.heatmap(confusion_matrix(y_test, y_pred), annot=True, fmt='d', cmap='Blues',
            xticklabels=["No Diabetes", "Diabetes"],
            yticklabels=["No Diabetes", "Diabetes"])
plt.xlabel("Predicted")
plt.ylabel("Actual")
plt.title("Confusion Matrix")
plt.show()

# Print evaluation metrics
print(f"Test Accuracy : {acc_test:.4f}")
print(f"Precision      : {prec:.4f}")
print(f"Recall         : {rec:.4f}")
print(f"F1 Score       : {f1:.4f}")
```








```
Test Accuracy : 0.7143
Precision     : 0.6087
Recall        : 0.5185
F1 Score      : 0.5600
```

In [10]:
```
# I found this plot function and it is really crazy how detailed it gets
sns.pairplot(df, hue = 'Outcome')
```

Out[10]:
```
<seaborn.axisgrid.PairGrid at 0x14e2e640770>
```


Pregnancies
Glucose
BloodPressure
SkinThickness
Insulin
BMI
DiabetesPedigreeFunction
Age
Outcome
0
1

In [ ]: